

Factor Shares in Finnish Industry Over the 20th Century: Descriptive Evidence

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Tiivistelmä/Referat – Abstract			
<p>Within the last forty years, capital has increased its share of national income at the expense of labour across developed and developing economies, with few exceptions. The trajectory has been successfully linked to technological change, globalisation and the erosion of the bargaining power of employees in theoretical and empirical examinations. Due to short time series, it has remained unclear whether the increase in capital share is a consequence of modern trends, such as hyperglobalisation or the ICT-boom. Recognizing the mechanisms behind the increase is worthwhile from the social planner's viewpoint, because of factor shares' connection with personal income inequality and unemployment, both triggers of social unrest.</p> <p>This thesis examines the connection between labour income share and its potential determinants in Finnish industry, namely technological change, globalisation, union power, devaluations, capital mobility and public expenditure between 1907 and 2015. The main empirical strategy used was the fixed effects regression, where the first three aforementioned determinants were proxied with capital intensity, total factor productivity (TFP), import and export exposure, union density and the number of strike days per worker, while controlling for branch fixed effects, common national trends and branch-specific trends. The last three country-level determinants were studied using time series analysis. The primary data source was Bank of Finland's Growth studies, which was complemented with the data in various volumes of the Official Statistics of Finland, in addition to selected separate publications.</p> <p>According to the results, technological change has a negative effect on labour share, while union power and import exposure have a positive impact. Periodizing, the increase in capital intensity can more than explain the decrease in labour share from 1907 to 1943. Between 1943 and 1991 the quadrupling of union density accounts around a third of the 28.2 percentage point increase in labour share. From 1991 to 2007, the acceleration of TFP growth rate can predict around 60% of the 23.7 percentage point decline in labour share.</p> <p>The findings suggest, that technology is the key driver of functional income distribution also in the long-term, which complements its importance in the recent increase in capital shares, covered in previous research. Moreover, in the early 20th century technology appears to have worked more as a substitute for labour, while after mid-century it has become rather complementary and efficiency-improving. In addition, the ICT era has brought along an increase in market concentration, implying that technology operates also potentially through rising economic rents. Union power had a non-trivial role in inflating labour share during the post-WWII decades. Finally, import exposure has increased labour share presumably by squeezing profits, but its significance is overshadowed by the other covariates.</p>			
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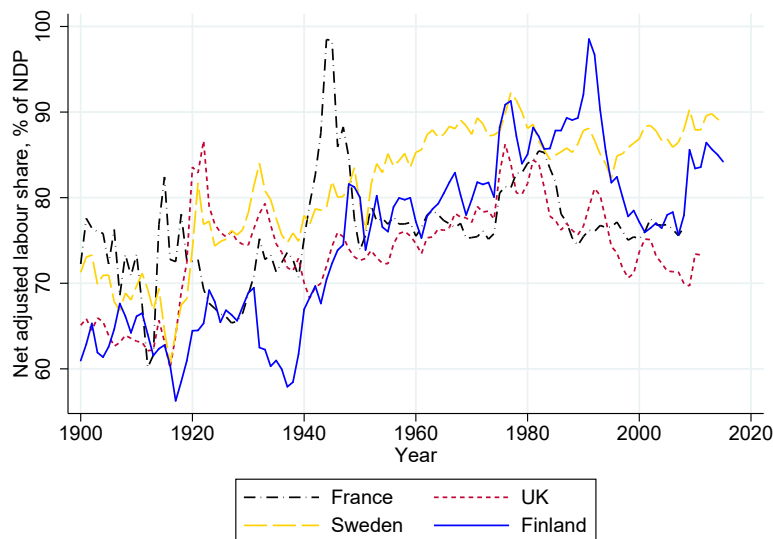
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1 Introduction

Figure 1: Net adjusted labour share in selected countries 1900–2015



Source: France and UK: Piketty 2016; Sweden: Bengtsson & Waldenström 2017; Finland: Heikkinen & Lindfors (forthcoming).

During the last forty years or so, the income split between wages and capital income has turned drastically in favour of the latter in practically all rich Western economies. This trajectory has puzzled the academia because of its extent and difficult interpretation. Is it another manifestation of rising inequality within countries, or an unforeseen shift in the means of production, with no connection to economic inequality? While the evidence is not fully consistent, the conventional wisdom is, that the decreasing labour share is related to the rising inequality in personal level, arising from the great concentration of capital income relative to wages.

In addition to the valuable insights considering economic inequality, the decreasing labour share has been claimed to indicate a transformation towards a more capital-intensive economy. As such, it has been linked to automatisisation and to a growing worry of the demise of labour as we know it. Perhaps the most well-known warning comes from Brynjolfsson and McAfee, who state that unless the issue is tackled with

policy, part of the population ends up having ‘nothing to offer’ to businesses.¹

Since the proposed outlooks following diminishing labour share are altogether grim, a question of what one should do in order to stop the ongoing trend has emerged. But in order to come up with the appropriate policy suggestions, one must know what exactly determines the income share of labour. Without an accurate diagnosis, the policy can turn out counterproductive.

Figure 1 presents the net adjusted labour share in Finland and a few other European economies. Considering the sample at hand, the big picture looks remarkably similar: after a turbulent half a century, the labour share grows after WWII for some 40 years, and then decreases another four decades. Because of the apparent similarity in trend and timing, the recent downhill has been suggested to result from global factors, such as accelerating globalisation and technological change.² However, because the lack of data, the long-term determinants of labour share have rarely been examined. Thus, the story of decreasing labour share in a more globalized and automatized world has been missing a robustness comparison to the more autarchic and technologically-regressed past.

In this thesis, I exploit the relatively abundant Finnish data considering the labour share and the most common explanatory variables. My aim is to provide empirical evidence about the long-term determinants of labour share, particularly in Finland, but hopefully extensible to similar economies as well. My research question is the following:

- What factors have determined the changes in labour share in Finnish industry over the 20th century?

To sum up my results, I find that the variation in labour share is mostly due to technological advancement and changes in bargaining power. The impact of technology is primarily based on a negative relation between labour share and total factor productivity. It affects secondarily through capital accumulation. However, capital accumulation appears to be partly capturing the influence of an increase in the bargaining power of employers. Working to the opposite direction, union den-

¹Brynjolfsson and McAfee 2011, p. 8.

²*Labour Losing to Capital: What Explains the Declining Labour Share?* 2012.

sity's positive coefficient signifies a boost to the bargaining power of labour. Finally, positive connection between import exposure and the labour share is interpreted to benefit the employee-side as well, by cutting profits on product markets.

The structure of this thesis is the following: after introduction, I represent the theory around labour share in chapter 2. Next, I give a brief introduction to previous research considering the subject in chapter 3. In chapter 4, I construct a theoretical model to illustrate the mechanisms behind the labour share, which is empirically tested in chapter 7. In between, I cover the empirical methodology in chapter 5 and describe my dataset in chapter 6. In chapter 8 I build a historical narrative, trying to explain the empirical results, and connect the narrative to the theoretical model to make my claims as transparent as possible. Chapter 9 concludes.

2 Theory

Among research papers considering functional income distribution, its common practice to start out with a quick reference to Nicholas Kaldor. Kaldor famously stated, that the income split between capital and labour, more conveniently known as factor shares, is a remarkably constant condition.³ Later, this statement, and five others, were titled nobly as Kaldor's facts. As mentioned, the reference is quite frequent, and not least because this particular fact turned out to be fiction: from around the 1990s, the long-lived steadiness of capital and labour share began to appear markedly outdated, as capital increased its piece regardless of national borders. Kaldor's statement, however, faced also serious contemporary scepticism, notably exemplified by Solow and Arrow et al.⁴ Though Kaldor's claim does not awake much heated debate anymore *per se*, the discussion around factor share determinants is still very much alive.

2.1 Long-term explanations

Neither the long run development nor drivers of factor shares have evoked nearly as much attention as the medium run. A few efforts of theorizing the regularities still exist. Firstly, there is the story of remarkable stability: like Kaldor rightfully noted, regardless of the enormous leaps in economic development labour and capital share have proven to be surprisingly constant variables on aggregate level. According to Lebergott, the stability of factor shares is a very logical consequence of the stability of factor prices. Because factor prices drift towards equilibrium, they never invoke any considerable shocks to shares. The price of capital, r , is highly dependent on the wage rate, w , paid on the industry that produces the capital goods. Hence, if the wages rise, capital's price follows, and the two never alter from each other significantly. Market mechanism eliminates wage differentials between industries, which guarantees that the correlation between capital price and wage rate remains unbreakable.⁵

³Kaldor 1957, pp. 591–593.

⁴Solow 1958; Arrow et al. 1961.

⁵Lebergott 1964, pp. 57–64.

Some fifty years of new data and a pile of studies since the days of Kaldor and Lebergott, there is a fairly well-established consensus that the factor shares are not so stable as they used to appear. Shares variate without a doubt on the medium term, and despite the aggregate level stickiness, there are significant industry level differences. One famous theory predicting shifts in factor shares is the good old Kuznets curve. Named after its celebrated developer, the Kuznets curve tells that the industrial revolution first favours the capitalists and skilled employees, which realizes as an increasing capital share. After a while, the excess profits created by technological advancement diminish, and the complementariness between capital and the skilled workforce eases. At the same time, the excess supply of unskilled employees runs out, experience and productivity of the oldest of the unskilled rises, and their relative and absolute number grows. Thus, the relative position of labour inevitably improves, signifying a decrease in capital share. During this period of change and adjustment which, according to Kuznets, can take for a solid hundred years, the capital share draws a U-shaped pattern.⁶

The Kuznets curve is, of course, a pretty simplistic prediction. Its vagueness allows lots of flexibility which can be rightfully judged of inconsistency: because the hypothesis that Kuznets curve sets is so crude, its success really depends on arbitrariness.⁷ There is no standard framework to test whether the capital share is U-shaped or not. A harsher piece of critique, coming from Piketty, claims that Kuznets' theory is nothing more but a Cold War product. According to Piketty, Kuznets curve's real intention was to prevent developing countries from turning into communism. The idea is that the curve had a soothing mission: the modernisation process will eventually eliminate capitalism-driven inequality, so there is no need to pursue a more egalitarian society.⁸

In Piketty's view, economic inequality decreased during the short 20th century because of the political and economic turmoil during 1914–1945. The two world wars and the Great Depression demolished capital and brought a change in politics, which

⁶Schön 2004, p. 4.

⁷A refined version of the Kuznets curve, known as the Kuznets cycle, represents the possibility of numerous Kuznets curves. In contrast to Kuznets curve, Kuznets cycle is not tied to the industrial revolution, and can be initiated by any break in the economy. Nonetheless, the pitfall of arbitrariness remains. For a more detailed description, see Milanovic 2017; Schön 2004.

⁸Piketty 2016, p. 25.

drove down the importance of capital income and began an unforeseen redistribution of earnings through taxes and transfers. The position of employees was also strengthened, since the public opinion demanded, and the wartime effort had to be compensated. In short, while Kuznets curve states that inequality varies due to economic forces, Piketty stresses politics. Piketty's hypothesis could be criticized appealing to a lack of causal or even descriptive statistical evidence: while the narrative may sound persuasive, capital incomes could have shrank because of any unknown factor which changed simultaneously with politics.

2.2 Medium-term explanations

2.2.1 Technology

The very first and still the most popular theory considering the determination of factor shares in the medium term is the neoclassical one. In neoclassical theory, factor shares are determined solely by production technology. Shocks to production technology, practically the non-stopping technological advancement, either alters relative factor prices or factor endowments. Plainly, the relationship can be stated as

$$\frac{\text{total profits}}{\text{total wages}} = \frac{r}{w} \times \frac{K}{L} \quad (1)$$

where r is the price of capital, w is the wage rate, K is capital and L is labour.⁹ The relation between the two ratios in the right-hand equation is taken as given: when relative factor prices $\frac{r}{w}$ increase, the relative factor endowments $\frac{K}{L}$ must decrease.¹⁰ This is intuitive: if the price of capital relative to labour increases, the relative amount of capital has to shrink, when businesses substitute from relatively expensive capital to cheap labour. In other words, if one ratio changes, the sign of the other ratio's corresponding change is assumed to be known. With the help of this assumption, it is possible to define another crucial concept, known as the

⁹See, for example Atkinson 1975, p. 171; Glyn 2011, p. 105.

¹⁰Atkinson 1975, p. 171.

elasticity of substitution:

$$\text{elasticity of substitution} = \sigma = \frac{\text{percentage change in } \left(\frac{K}{L}\right)}{\text{percentage change in } \left(\frac{w}{r}\right)} \quad (2)$$

Elasticity of substitution is the formal statement of the relation between $\frac{r}{w}$ and $\frac{K}{L}$. It reveals how much the capital-labour ratio changes when the relative price of labour changes by one percent, and is a positive number by definition.¹¹ From equation (2) it becomes immediately clear, that if capital-labour ratio responds more than proportionately to a one percent change in relative price of labour, elasticity of substitution is above unity. In that case, technical change is said to be *capital augmenting*. When technical change is of capital augmenting nature, the quantity effect dominates the price effect in equation (1). When this happens, technical change increases capital's share of income.

In empirical literature, elasticity of substitution is typically estimated to be below unity.¹² So in real world, price effect often overcompensates the quantity effect, and technical change is *labour augmenting*, accordingly. The causal channel is by no means definitive: it is equally possible that changes in relative factor supply yields a change in relative factor price.¹³ Regardless of the causality's direction, however, equation (2) holds, and the elasticity of substitution can be defined.

Elasticity of substitution is closely related to another well-known trajectory, called *skill-biased technological change*. This refers to a phenomenon where technological progress treats employees unevenly, regarding to their skill-level. Specifically, technological change enhances a trend where capital works as a complement for the skilled and substitute for the unskilled.¹⁴ Therefore, technological change's net effect on labour share becomes ambiguous: it depends on which impact is the dominant one, the former or the latter.¹⁵ In recent decades, the substitution effect has been suggested to become increasingly dominant, turning technological change actually capital augmenting. This turn implicates equivalently, that the elasticity of

¹¹Borjas 2010, p. 110.

¹²D. Autor, Dorn, F. Katz, et al. 2017, p. 1; Rowthorn 1999.

¹³O. J. Blanchard, Nordhaus, and Phelps 1997, p. 94.

¹⁴Borjas 2010, p. 300.

¹⁵Guerriero and Sen n.d., p. 7; Schneider 2011, p. 16.

substitution has risen above unity.¹⁶

The reason why technological change includes a skill-level bias lies in productivity. Modern capital, for example ICT-capital, boosts the productivity of the skilled workforce.¹⁷ However, in many unskilled occupations like service jobs, boosting the productivity of labour is difficult: better scissors or the latest cash register might improve barber's and cashier's productivity by a bit, but not much. Therefore, labour is substituted by tireless and fixed-cost capital whenever possible. In the above example, the barber's job could prove too costly to substitute, but the cashier might not be so lucky.¹⁸

The neoclassical explanation of technology as the sole determinant of factor shares has a few caveats. Firstly, it assumes perfect competition.¹⁹ With the postulation of factor shares evolving in a vacuum where technological advancement is the only thing that can produce variation, neoclassical explanation states that firms or employees have no bargaining power. Secondly, there are the measurement issues: there is no collective consensus about the indicator for technological advancement. Commonly used proxies for technological progress are, for example, ICT capital, capital-labour ratio, TFP growth rate or simply time trend. Every one of these measures includes apparent interpretative difficulties, which is not surprising since technological change is not something directly observable.²⁰

2.2.2 Globalisation

Perhaps the second most popular explanation for changes in factor shares is the intensity of globalisation. Globalisation refers vaguely to the increasing international circulation of products and factors. It effects factor shares through both.

¹⁶Dünhaupt 2013; Stockhammer 2013, p. 5.

¹⁷Hamermesh 1996, p. 351.

¹⁸The difficulty of automating different occupations is related to the research around labour market polarisation, famously addressed in D. H. Autor, Levy, and Murnane 2003. Considering my example, barber's occupation represents a manual occupation, while cashier could be categorized as a routine cognitive occupation. According to the routinisation hypothesis presented in Autor, Levy & Murnane, due to a relatively large amount of programmable routine task-input, cashier's work is more likely to be automated than barber's. See also D. H. Autor 2015.

¹⁹Atkinson 1975; Dünhaupt 2013; Glyn 2011, See, for example.

²⁰Borjas 2010, p. 301; Stockhammer 2013, pp. 11–12.

Trade theory has certain implications about the expected effect of international trade on factor shares. The most direct prediction comes from Heckscher-Ohlin (H-O) theorem. The Heckscher-Ohlin theorem states, that "each country will export the good that uses its abundant factor intensively".²¹ The inevitable outcome of this is that the abundant factor gains from international trade, while the scarce factor loses. Instead of letting the forces of demand and supply diminish the price of the abundant factor, trade allows countries to specialize. Specializing enables an economy to focus its production on the factor-abundant industry. Hence, the relatively abundant factor is absorbed without decreasing its price. Consequently, the factor prices equalize: the abundant factor's price, which was low on a state of autarchy, rises because international trade increases its demand. The scarce factor's price, which was high on autarchy, drops as international trade expands its supply.²²

Another relevant theory considering trade and factor shares is the Stolper-Samuelson theorem. The theorem claims, that as a product's relative price increases, so does the real rate of return on that factor which is primarily exploited in its production. Simultaneously, the other factor's real rate of return decreases. Simply put, the predictions of the Stolper-Samuelson theorem further intensify the mechanism described in the H-O theorem.²³

According to the above theorems, employees in poor countries should gain from international trade. Trade allows these countries to specialize in labour-intensive production, and expands their potential market from local to global. However, inequality in terms of both personal and functional income distribution has experienced a growing trend in poor countries in the recent few decades as well.²⁴ Clearly contradicting with theory, this anomaly has been reasoned with a few possible explanations: first, the internationally driven demand for exporting industries in poor countries might have benefitted exclusively the skilled workforce. In other words, the unskilled employees in rich countries have been substituted with the skilled in poor countries, while trade has represented the transmitting mechanism. Second,

²¹Feenstra 2004, p. 32.

²²Dünhaupt 2013, p. 16; Feenstra 2004, pp. 32–35; Freeman 2009, pp. 583–584.

²³Guerriero and Sen n.d., pp. 3–4; Feenstra 2004, pp. 15–16; Stockhammer 2009, p. 12; Stockhammer 2013, p. 6.

²⁴Freeman 2009, pp. 591–592.

the anomaly could be due to the usual suspect, skill-biased technological change: as poor countries have copied and utilized technology from rich countries, it rewards mainly the skilled, through same logic as in rich countries.²⁵

As it was with the neoclassical explanation, trade theory is not flawless. It comes with different variations, which necessarily have divergent presumptions and conclusions. The H-O theorem and the Stolper-Samuelson theorem both imply that the relative factor endowments are the principle driver behind the ongoing international trade. Despite of the intuitive appeal, they fail to address the growing inequality in poor countries. Ricardian trade models which draw their predictions from technological differences and comparative advantage, prove more successful in this endeavour. In Ricardian spirit, technological differences between countries create differences in factor demand, which induces factor flows. Therefore, skilled workforce and capital drift towards rich countries, magnifying the initial factor endowments between countries. Accordingly, the supply of ‘good jobs’ increases in rich countries, while it decreases in poor countries. Hence, the factor flows actually reduces inequality in advanced countries, and increases it in poorer countries.²⁶

Because of the poor predictive power of the above presented mainstream trade theories, other explanations determining the relation between trade and labour share have been put forward. In contrast to technology or factor endowments, one hypothesis emphasizes market imperfections. According to Schneider, trade decreases that factor’s income share which is enjoying bigger excess profits.²⁷ It could be either the labour or capital, depending on the relative leverage of unions and businesses. I refer to this hypothesis as the excess profit hypothesis and with the benefit of hindsight claim it to be the most appropriate in the context of Finnish industry.

The flow of factors plays a vital part in another phenomenon occurring with globalisation, namely financialisation. Globalisation continuously transforms – and for a large part, has transformed – labour and capital markets from national to global scale. Especially during the 1990s, when China, India and the former Soviet bloc opened up rapidly to the world market, the global relative factor endowments experi-

²⁵Freeman 2009, p. 592.

²⁶Ibid., pp. 584–585.

²⁷Schneider 2011, pp. 23–24.

enced a drastic change. Combined with capital mobility, the low capital-labour ratios in the newcomer countries expanded the range of investment opportunities.²⁸ The mobility guarantees that capital can be placed or outsourced wherever it produces the highest return. Accordingly, increasing outsourcing or a threat of outsourcing can intensify capital's chase for profits, which results in a downward pressure on labour share.²⁹

Measuring abstract phenomena like globalisation or financialisation is tricky. The conventional indicator for the former is the GDP share of exports and imports.³⁰ Alternatively, globalisation has been proxied with the value of imports, transformed to mimic the costs of domestic production.³¹ Financialisation is a more recent determinant candidate for factor shares and hence has appeared in previous research only on occasion. It has been proxied by GDP share of external liabilities and assets and foreign direct investment flows.³²

2.2.3 Bargaining theory

Third theory tradition closely connected to factor shares is bargaining theory. According to bargaining theory, employers and employees partake in a distribution of rents as they negotiate over prices and wages. In a situation of perfect competition, neither parties have any bargaining power, and they take prices and wages as given: prices gravitate towards equilibrium in production markets, and wages adjust to supply and demand in labour markets. Bargaining theory abandons the ideal of perfect competition, and states that both employers and employees pursue excess profits and wages, respectively. Hence, prices and wages are settled in a negotiation process, conditioned to corresponding bargaining power of both parties. Increase in monopoly power puts upward pressure on prices and, consequently, profits, as an

²⁸Freeman 2009, pp. 577–579; Jaumotte and Tytell 2007, pp. 161–162.

²⁹*Understanding the Downward Trend in Labor Income Shares* 2017, p. 131; Stockhammer 2013, pp. 7–8.

³⁰For example in *The Labour Income Share in the European Union* 2007; Guerriero and Sen n.d.; Harrison 2005; Stockhammer 2013.

³¹Elsby, Hobijn, and Şahin 2013, p. 41.

³²Guerriero and Sen n.d., p. 22; *Understanding the Downward Trend in Labor Income Shares* 2017, p. 125; Stockhammer 2013, p. 19.

addition in union power drags up wages, and henceforth the wage bill.³³

Theoretically, there is some ambiguousness about the effect of union power to labour share. The loss of consensus considers especially the labour market institutions in general. On one hand, strengthening the labour market institutions might boost the labour share up on the short run, but on the long run, however, more employee-beneficiary institutions may spur unemployment. As militant unions drag the equilibrium wage up it might eliminate job opportunities, increase unemployment, and turn the net effect negative. Equivalently, bigger unemployment benefits can create incentives to prefer unemployment instead of gently constraining labour supply. Empirically, the intuitively more plausible positive effect of union power has been hard to establish.³⁴

The difficulty of verifying union premium of labour share statistically might be a bit due to measurement problems. The classical proxy for union power is union density and another quite used is the number work days lost due to strikes.³⁵ Union density does not experience much variation over time, which can make its impact hard to identify. It also does not measure exactly what one is looking for when trying to capsule union power: the behaviour of unions can change in time through number of reasons which do not yield instant feedback to density. Another issue is endogeneity: it is quite possible that the relation between union density and labour share, which is of interest here, does not run solely from the first to the latter. Instead the two variables could experience simultaneous causality: changes in labour shares causes changes in union density, as well.³⁶

A firm with monopoly power squeezes labour share by setting prices higher than competitive firm. In theory, monopolist actually pays equal wages compared to competitive firm, i.e. $w_M = w_C$.³⁷ The negative effect on labour share stems from the higher-than-normal prices, which yield excess profits and result naturally to a reduction in labour's share of value added.³⁸

³³Atkinson 1975, pp. 174–175; O. J. Blanchard, Nordhaus, and Phelps 1997, pp. 101–103; O. Blanchard 1998, p. 6.

³⁴Schneider 2011, p. 23.

³⁵Schneider 2011, p. 23; Bengtsson 2014, p. 306; Bentolila and Saint-Paul 2003.

³⁶Visser and Checchi 2009, p. 237.

³⁷Borjas 2010, pp. 197–198.

³⁸O. J. Blanchard, Nordhaus, and Phelps 1997, pp. 101–103.

Since monopoly is the only producer on the market, its production decision affects inevitably on the price. Analogous to competitive markets, when monopoly increases production, the price it receives decreases. The fact that monopolist's production affects the price is an important insight: it leads to a situation where it is rewarding for a monopoly to restrain its production.³⁹ Intuitively, because monopoly restrains its production to maximize profits, it logically also employs less than a competitive firm.⁴⁰

There are couple of widely popular indicators for monopoly power. First of these is cumulative market share of n largest firms or simply a concentration ratio. The obvious disadvantage of the concentration ratio is that it only pictures market structure at an arbitrary point n . Industries with different market structures can produce an identical ratio, and the structure of an industry might look different at an alternative point. A little help to these caveats provides another measure, known as the *Herfindahl-Hirschman Index (H)*. The index is produced through a simple calculation: $H = \sum_{i=1}^n s_i^2$, where s_i is the market share of the i th firm. As such, it includes a slightly more info about the specific market structure of an industry than the concentration ratio.⁴¹

In addition to the measurement problems above, the definition of markets is another source of complexity. In the case of some businesses, producing possibly a great variation of products at home and abroad, their market of operation is hard to point out. The definition of markets is necessarily arbitrary and often hinges on the classification done by statistical authorities for very different purposes. Finally, the relation between monopoly power and profits is possibly endogenic. It is plausible that a fierce price competition forces the surviving companies to rely on scale production, which decreases the share of labour. Thus, harsh competition could lead to low labour shares and great market shares alike.⁴²

³⁹Pepall, Richards, and Norman 2011, pp. 24–28.

⁴⁰Borjas 2010, pp. 92–93 & 197.

⁴¹Pepall, Richards, and Norman 2011, pp. 66–68.

⁴²Ibid., pp. 68–72.

3 Previous research

The interest in functional income distribution must be justified. It is not an ideal indicator of economic inequality, so what is the essential motivation? According to Atkinson, factor shares connect valuably income distribution's macro and household levels. Because capital income is a lot more concentrated than labour income, factor shares offer us an informative glance to personal income distribution.⁴³ Secondly, they allow examining income distributions' fairness from the perspective of income sources, which is stressed by Glyn.⁴⁴ As an empirical verification, Bengtsson and Waldenström present persuasive long-run evidence about a negative connection between labour share and two personal inequality measures, top income shares and Gini coefficients.⁴⁵ There is no uniform consensus, however: Francese & Mulas-Granados dig into the same issue with a modern, multinational dataset spanning from 1970 to 2013, and find contradictory results.⁴⁶ Nonetheless, it is safe to say, that typically some inverse relation between labour share and economic inequality is expected.

Bassanini and Manfredi throw out another intriguing question, by asking whether the universal rise in capital shares, often denoted to technological change, is a temporary phenomenon or a lasting trajectory unless addressed?⁴⁷ To put differently, in terms of shrinking labour shares is there more to come, *ceteris paribus*? Rognlie provides a sceptical view, arguing that labour share is just balancing back to its post-WWII state, instead of plunging to an endless pit.⁴⁸ Rognlie's time frame is also longer than usual, but not as long as the one in Piketty, whose projections share the same pessimism as Bassanini and Manfredi.

⁴³Piketty 2016, pp. 224–225.

⁴⁴Atkinson 2009; Glyn 2011, p. 103.

⁴⁵Bengtsson and Waldenström 2017, pp. 11–16.

⁴⁶Francese and Mulas-Granados 2015, pp. 15–17.

⁴⁷Bassanini and Manfredi 2012, p. 35.

⁴⁸Rognlie 2015, p. 12.

3.1 Measurement issues

Typically, factor shares are determined by firstly calculating the labour share and regarding the rest bluntly for capital. Strictly speaking, labour share is the proportion of value added that goes for labour, stated formally as:

$$LS = \frac{\text{employee compensation}}{\text{value added}} = \frac{W \times L}{P \times Q} \quad (3)$$

where W is the average employee compensation, L is the labour input, P is the price of production and Q is the quantity of production.

Capital share refers to the proportion of value added paid for capital, i.e. the proportion of capital income. Capital income consists of rents, dividends, profits, capital gains, royalties and other income, which is due to owning land, real estate, financial capital, productive capital or other kinds of capital.⁴⁹ Normally, factor shares are defined exploiting the data in National Accounts. Not surprisingly, the crude split does not come without difficulties. Either one of the variables can include easily something unwanted, without certain adjustments. Firstly, when calculating factor shares one should use value added in factor prices rather than market prices as a denominator. Otherwise the capital share will include indirect taxes and transfers, which do not account as capital income.⁵⁰

Next, it is necessary to decide whether one is interested in gross or net shares: in other words, should we pick gross or net value added. While net shares describe specifically ‘who gets what’, gross shares reveal more about the production structure of economy: is production capital or labour intensive, respectively. The former is a better indicator for inequality and the latter measures specifically economy’s factor dominancy. Commonly, the choice is determined by data availability.⁵¹

The labour income of self-employed is rarely specified when collecting data. Their total income is regarded as ‘mixed income’ instead.⁵² Should mixed income be ac-

⁴⁹Piketty 2016, p. 28.

⁵⁰See, for example, Bengtsson 2014, p. 293; Bengtsson and Waldenström 2017, p. 44 or Glyn 2011, p. 108

⁵¹More in Bengtsson and Waldenström 2017, pp. 43–44; Glyn 2011, p. 108; Rognlie 2015, pp. 3–7 or Schwellnus, Kappeler, and Pionnier 2017, p. 9

⁵²Piketty 2016, p. 189.

counted as labour or capital income? This is a key question and presents the most crucial adjustment yet: the imputation of self-employed income. The adjustment is especially important in longer series as the relative amount of self-employed changes drastically. After this adjustment, labour share is transformed into *adjusted labour share*, which is commonly formulated in literature as:

$$ALS = \frac{W \times E}{VA} \times \frac{(E + SE)}{E} = \frac{W \times (E + SE)}{VA} \quad (4)$$

where W is the average wage of employees, E is the number of employees and SE is the number of self-employed.⁵³ The adjustment's effective meaning is that wage level of employees and self-employed is set equal, in practice.

The above corrections are standard procedures in empirical work. Additionally, one can problematize other things. For example, how should one handle owner's earnings is a valid question. Typically, owner's earnings are accounted as labour income, since they appear in businesses' wage bills, but this is due to a data feature and not a necessity.⁵⁴ The trouble around owner's earnings signify the fact that growing wage dispersion might actually increase labour's share, which makes it defective indicator of inequality. Another issue is changes in production structure: when looking at factor shares at the aggregate level the changes stem from within and between industries. The latter implicates that variation in proportions of total value added between industries reflect to aggregate level changes in factor shares which might delude into false conclusions.⁵⁵ Lastly, there is the puzzle of non-market sector. Since non-market employers, like governments and households, do not produce any profit, their net value added is calculated through costs, yielding a labour share of 100 percent. Hence, variation in the non-market sector's proportion of total GDP creates unwanted aggregate level changes. In the other extreme, in owner-occupied housing labour share converges to zero. Thus, factor share calculations routinely focus on mere market sector.⁵⁶ This hold true for the study at hand, as well.

⁵³See Arpaia, Pérez, and Pichelmann 2009 or Elsby, Hobijn, and Şahin 2013.

⁵⁴Krueger 1999, p. 3.

⁵⁵Arpaia, Pérez, and Pichelmann 2009, pp. 7–8; Kyrrä 2002, pp. 7–9.

⁵⁶Dünhaupt 2013, p. 2; Glyn 2011, pp. 109–112.

3.2 Determinants

The research considering determinants of factor shares is for the most part empirical. Methodology relies typically on panel regressions, where the above theories are tested via regressing labour share with different proxies for technological change, globalisation and bargaining power. The data starts usually from around the 1970s, and is collected on cross-country or cross-industry level. Theoretical approaches represent a minority.

Interest towards the drivers of functional income distribution has been on the rise in the 2010s as the spectacularly uniform decline in labour shares from around the 1980s has become better documented. It was covered famously by Piketty and Zucman, who point out a parallel contraction in Continental European and Anglo-Saxon countries, but also in Japan.⁵⁷ Dünhaupt discovers the decline, as well, but clarifies that the Anglo-Saxon experience is somewhat less distinct.⁵⁸ Glyn examines longer time series, and adds, that in many industrialized countries labour share draws a hump shape over the 20th century, which peaks somewhere after the 1960s.⁵⁹

Similarly to competing theories, technological change is the most successful determinant of factor shares among research papers as well. As a prominent example European commission (EC) finds technology, proxied by capital-labour ratio and ICT capital, the most important driver of labour share. EC's results are based on panel regressions in a cross-country dataset consisting of various European countries. Evidence in favour of skill-bias is also presented.⁶⁰ Jaumotte and Tytell carry out similar analysis with similar methodology and variable definitions, finding similar results.⁶¹ Hutchinson and Persyn follow suit, proxying technological change with total factor productivity and capital-output ratio. Their panel dataset is a cross-country-industry mix.⁶² Bassanini and Manfredi count on identical proxies as Hutchinson and Persyn and come up with comparable conclusions, operating also on country

⁵⁷Piketty and Zucman 2014.

⁵⁸Dünhaupt 2013.

⁵⁹Glyn 2011.

⁶⁰*The Labour Income Share in the European Union* 2007, pp. 255, 259–260.

⁶¹Jaumotte and Tytell 2007, pp. 13–16.

⁶²Hutchinson and Persyn 2012, pp. 29–30, 36.

and industry level.⁶³ A more recent paper from IMF reaffirms their results from ten years back. This time, IMF uses a relative price index of investment goods as a proxy for technological advancement.⁶⁴ On theoretical side, Karabarbounis and Neiman utilize also the relative price of investment and declare its decline as the most important driver of the global decrease in labour shares, controlling for other sources of capital augmenting technological growth.⁶⁵ Finally, Arpaia et al. adapt an approach combining modelling and calibration where technology strikes out as the winning determinant.⁶⁶

Common in social scientific work, the evidence connecting technology and factor shares is not unanimous. For example, running panel regressions with a dataset including 89 countries in total, Guerriero and Sen find actually a positive correlation between technological change and labour share. Their proxies are, however, deviant from the ones introduced above: number of patent applications and R&D expenditure, to be precise. Interestingly, Guerriero and Sen discover a negative effect for mechanisation, measured as the proportion of machinery and equipment capital of the overall capital stock.⁶⁷ Another contradictive finding is represented by Harrison. With a dataset resembling Guerriero and Sen's in width, only older, she reports a negative relation between labour-capital ratio and labour share, implicating equivalently a positive relation between capital-labour ratio and labour share.⁶⁸

Additionally, Stockhammer has strongly criticized the proxies and methodology used in verifying the effect of technological change. According to Stockhammer, without controlling for time fixed effects the regression coefficients on technology variables become biased. Also, proxying technological change with a time trend is reprehensible.⁶⁹ In a later article Stockhammer, however, finds a significant negative effect of capital-labour ratio to labour share.⁷⁰ For a summarisation, the majority of evidence suggest that technological change has both economically and statistically significant

⁶³Bassanini and Manfredi 2012, pp. 11–13, 35.

⁶⁴*Understanding the Downward Trend in Labor Income Shares* 2017, pp. 136, 161.

⁶⁵Karabarbounis and Neiman 2013, abstract.

⁶⁶Arpaia, Pérez, and Pichelmann 2009, pp. 27–28, 35.

⁶⁷Guerriero and Sen n.d.

⁶⁸Harrison 2005, pp. 4, 22–23.

⁶⁹Stockhammer 2009, pp. 11, 42.

⁷⁰Stockhammer 2013, pp. 42–43.

negative effect on labour share. However, the sign of the effect may vary, depending on whether the technical progress happens on areas clearly signified by the exploitation of raw labour. Moreover, the net effect of technological advancement might turn blurry, if the dataset covers great number of developing economies alike.

Globalisation places second when comparing the most important driver of factor shares among earlier research. Its effect is typically established through negative regression coefficient for trade share or trade openness, which is the sum of imports and exports divided by GDP. For example, Harrison finds trade share the most plausible candidate behind the fall in labour shares.⁷¹ Stockhammer uses the same variable definition and comes up with an identical conclusion.⁷² EC reports a similar negative impact for trade share, too, although its magnitude is overshadowed by technological progress.⁷³ Guerriero and Sen find openness' effect negative in developed countries.⁷⁴

With slightly altering definitions and approaches the conclusion of trade's negative effect seems to maintain robustness. Böckerman and Maliranta study trade's impact, defined as exports-output ratio, with firm-level data in Finland and find it explaining about a third of the fall in labour share from the 1970s onwards.⁷⁵ Jaumotte and Tytell proxy globalisation with the relative prices of exports and imports and report results that are in line with the ones above.⁷⁶ Elsby et al. take an interesting angle, defining globalisation as the percentage difference between total domestic requirements and total requirements per industry, again with familiar, negative outcome.⁷⁷

Considering financialisation I have only found two exemplary articles. Stockhammer argues strongly that financialisation is a great but underrepresented determinant of factor shares. Trying to capture its essence with the ratio of external assets and liabilities to GDP he finds a negative effect.⁷⁸ IMF proceed with an identical proxy

⁷¹Harrison 2005, p. 5.

⁷²Stockhammer 2009, p. 39.

⁷³*The Labour Income Share in the European Union* 2007, p. 258.

⁷⁴Guerriero and Sen n.d., p. 26.

⁷⁵Böckerman and Mika Maliranta 2012, pp. 268, 277.

⁷⁶Jaumotte and Tytell 2007, pp. 171–172.

⁷⁷Elsby, Hobijn, and Şahin 2013, pp. 41–42, 47.

⁷⁸Stockhammer 2013, pp. 19, 32–33.

variable and discover a negative impact alike, concerning, however, only advanced economies.⁷⁹

Reflecting against the theoretical attention, union power's effect on factor shares has appeared mysteriously non-existent in previous research. Since it is typically proxied with numerous variables, the blame cannot be put solely on measurement problems, either. Bengtsson argues strongly for the importance of union power, but union density comes out insignificant in his time series analysis on Swedish data.⁸⁰ In Stockhammer's work union density's impact is positive "rather consistently", but its robustness lingers on model specification.⁸¹ In a later article Stockhammer finds the relation between labour market institutions and labour share statistically insignificant.⁸²

Somewhat newer to the field, increase in monopoly power has proved to be a potential candidate behind declining labour shares in rich countries. Barkai attracted certainly some fresh attention by claiming that increase in market concentration, measured with the market share of n largest firms per industry, could explain the decrease in labour share in the U.S. by itself.⁸³ Autor et al. estimate a comparable regression and document an analogous impact, but do not draw as bold conclusions.⁸⁴ In another occasion, Autor et al. discover additional evidence of the universal nature of the negative correlation between monopoly power and labour share with a multinational firm-level dataset.⁸⁵ Hutchinson and Persyn report a modest, negative effect of an increase in concentration ratio to labour share in European Union member countries.⁸⁶ As a final example of empirical evidence, Azmat et al. identify a reverse correlation between barriers to entry and labour share. The idea is that restrictions to free market entrance strengthen the market power of those taking cover behind the barriers.⁸⁷

⁷⁹*Understanding the Downward Trend in Labor Income Shares* 2017, pp. 135–136.

⁸⁰Bengtsson 2014, pp. 292, 309.

⁸¹Stockhammer 2009, p. 53.

⁸²Stockhammer 2013, p. 31.

⁸³Barkai 2016, pp. 24–25.

⁸⁴D. Autor, Dorn, Lawrence F. Katz, et al. 2017, p. 5.

⁸⁵D. Autor, Dorn, F. Katz, et al. 2017, pp. 25, 47.

⁸⁶Hutchinson and Persyn 2012, p. 35.

⁸⁷Azmat, Manning, and Reenen 2007, pp. 21–23.

Diverging from the mainstream framework of panel regressions, Ripatti and Vilmunen combine modelling and time series econometrics, and conclude that the fall in labour share in Finland during the 1990s is most likely due to an increase in mark-ups. They suspect, however, that the growing mark-ups have been caused by product differentiation and increasing returns to scale rather than monopoly power.⁸⁸

Completely different viewpoints, outside the classical theoretical explanations, have also been put forward. Considering the Finnish experience, the significance of structural change behind the aggregate level changes in labour share has been highlighted by Kyyrä and Maliranta. The essential catch is that while different industries with differing levels of labour share either grow or contract in terms of total value added, the aggregate labour share varies, even though the labour shares within industries remains constant. The same goes within industries, too, as heterogeneous firms are established and shut down.⁸⁹ In contrast, Sauramo emphasizes the role of unemployment and rising mark-ups behind the decline in Finnish labour share over the 1990s.⁹⁰

In a broader context, another relatively common explanation for changes in factor shares, also neglected by theory, is politics. For example, Harrison suggests that an increase in government intervention pushes labour share up. She finds a positive regression coefficient for government spending as a share of GDP in panel regressions covering 100 countries.⁹¹ Stockhammer makes a similar discovery, although noting that the magnitude is minor compared to globalisation.⁹² In his long-term examination, Piketty puts the biggest weight on politics, as well.⁹³

The last controversial yet interesting proposition is offered by Rognlie, who questions the popular opinion about capital augmenting technological change, claiming that diminishing labour share is not a consequence of capital accumulation, but rather capital scarcity instead. He argues that the rising capital share emerges from housing

⁸⁸Ripatti and Vilmunen 2001, pp. 35–37.

⁸⁹See Kyyrä 2002, p. 7 and Kyyrä and Mika Maliranta 2006, pp. 18–22

⁹⁰Pekka Sauramo 2003, p. 41.

⁹¹Harrison 2005, pp. 4, 26–28.

⁹²Stockhammer 2013, pp. 11, 32–33.

⁹³Piketty 2016, p. 214.

capital, not productive capital, and is labelled with stagnant or shrinking capital stock along with excessively growing capital price.⁹⁴ This is a very different scenario compared to the traditional technology story, and if correct, it should move the focus of functional income distribution research from labour to housing market.

⁹⁴Rognlie 2015, pp. 2, 48.

4 The extended neoclassical model

In order to enhance understanding of the mechanisms behind the empirical results, in this chapter I introduce the widely popular neoclassical model, extended with market imperfections. The model here was first presented in EC 2007, and my contribution lies in minor simplifications.⁹⁵

I start with the familiar formulation of Constant Elasticity of Substitution (CES) production function:

$$Q = \left[\alpha (AL)^{-\rho} + (1 - \alpha) (BK)^{-\rho} \right]^{-\frac{1}{\rho}} \quad (5)$$

where α is a distribution parameter, ρ is a substitution parameter, and A and B represent the respective productive efficiencies. I.e. as A increases, the use of labour becomes more efficient, or alternatively, labour is saved. In addition, ρ and α satisfy the conditions $-1 < \rho < \infty$ and $0 < \alpha < 1$. Next, to ease interpretation later on, I derive an expression for the elasticity of substitution. By definition, elasticity of substitution is formulated as:

$$\sigma = \frac{\frac{d(K/L)}{K/L}}{\frac{d(MPL/MPK)}{MPL/MPK}} = \frac{d \ln \left(\frac{K}{L} \right)}{d \ln \left(\frac{MPL}{MPK} \right)} \quad (6)$$

where $MPL = \frac{\partial Q}{\partial L}$ is the marginal productivity of labour and $MPK = \frac{\partial Q}{\partial K}$ is the marginal productivity of capital. To tackle the quest at hand, I compute the first-order conditions for equation (5):

$$\begin{aligned} \frac{\partial Q}{\partial L} &= \alpha A^{-\rho} \left(\frac{Q}{L} \right)^{1+\rho} \\ \frac{\partial Q}{\partial K} &= (1 - \alpha) B^{-\rho} \left(\frac{Q}{K} \right)^{1+\rho} \end{aligned} \quad (7)$$

Next, after a few manipulations which I have left for the Appendix, I end up with

⁹⁵ *The Labour Income Share in the European Union* 2007, p. 264.

the wanted elasticity:

$$\frac{\partial \ln \left(\frac{K}{L} \right)}{\partial \ln \left(\frac{MPL}{MPK} \right)} = \frac{1}{1 + \rho} = \sigma \quad (8)$$

This implies equivalently, that $\rho = \frac{1-\sigma}{\sigma}$.

Given the expression for ρ , I can start to derive more informative formulations for both factor shares. Assuming that firms maximize profits, it is known that:

$$\begin{aligned} \frac{\partial Q}{\partial L} &= MPL = \frac{W}{P} \\ \frac{\partial Q}{\partial K} &= MPK = \frac{R}{P} \end{aligned} \quad (9)$$

where $\frac{W}{P}$, $\frac{R}{P}$ represent the real prices of both inputs.

Now, using (7), (8) and (9), labour and capital share can be expressed as:

$$\begin{aligned} LS &= \alpha \left(\frac{Q}{AL} \right)^{\frac{1-\sigma}{\sigma}} \\ CS &= (1 - \alpha) \left(\frac{Q}{BK} \right)^{\frac{1-\sigma}{\sigma}} \end{aligned} \quad (10)$$

According to equation (10), the relation between labour productivity, labour saving technology and labour share depends on the elasticity of substitution. Analogically, the relation between capital productivity, capital saving technology and capital share is determined by the elasticity.

Now, rewriting labour share in terms of $\frac{K}{L}$ allows us to examine how capital accumulation affects the labour share. Skipping again the details, the partial derivative of interest is:

$$\begin{aligned} \frac{\partial LS}{\partial \left(\frac{K}{L} \right)} &= \left(\frac{1-\sigma}{\sigma} \right) \alpha (1 - \alpha) \left(\frac{Q}{AL} \right)^{2\left(\frac{1-\sigma}{\sigma}\right)} \left(\frac{BK}{AL} \right)^{-\left(\frac{1-\sigma}{\sigma}\right)} \left(\frac{K}{L} \right)^{-1} \\ &\Rightarrow \begin{cases} \frac{\partial LS}{\partial \left(\frac{K}{L} \right)} < 0, & \text{when } \sigma > 1 \\ \frac{\partial LS}{\partial \left(\frac{K}{L} \right)} > 0, & \text{when } \sigma < 1 \end{cases} \end{aligned} \quad (11)$$

Where the implication in the end follows from the fact that all the other terms are

necessarily positive except for $\frac{1-\sigma}{\sigma}$. The conclusion from equation (11) is that an increase in capital accumulation, $\frac{K}{L}$, decreases labour share when the elasticity of substitution is above unity. It has the opposite effect when the elasticity is below unity.

Similarly, I can examine the effect of labour saving technology on labour share:

$$\begin{aligned} \frac{\partial LS}{\partial A} &= \left(\frac{\sigma-1}{\sigma}\right) \alpha (1-\alpha) \left(\frac{Q}{AL}\right)^{2\left(\frac{1-\sigma}{\sigma}\right)} \left(\frac{BK}{AL}\right)^{-\frac{1-\sigma}{\sigma}} A^{-1} \\ &\Rightarrow \begin{cases} \frac{\partial LS}{\partial A} > 0, & \text{if } \sigma > 1 \\ \frac{\partial LS}{\partial A} < 0, & \text{if } \sigma < 1 \end{cases} \end{aligned} \quad (12)$$

The above implies that an increase in labour saving technology increases labour share in case the elasticity of substitution is greater than one. The opposite happens when the elasticity is below one.

Next, I introduce the more plausible scenario, which accounts for imperfect competition. Suppose that there exist mark-ups, π , in the product markets, such that

$$\begin{aligned} \frac{\partial Q}{\partial L} &= MPL = \pi \frac{W}{P} \\ \frac{\partial Q}{\partial K} &= MPK = \pi \frac{R}{P} \end{aligned}$$

where $\pi > 1$.

Now, factor shares can be rewritten as:

$$\begin{aligned} LS &= \frac{W}{P} \frac{L}{Q} = W \frac{\left(\frac{\partial Q}{\partial L}\right)}{\pi W} \frac{L}{Q} = \frac{1}{\pi} \left(\frac{\partial Q}{\partial L}\right) \frac{L}{Q} = \frac{1}{\pi} \alpha \left(\frac{Q}{AL}\right)^{\frac{1-\sigma}{\sigma}} \\ CS &= \frac{1}{\pi} (1-\alpha) \left(\frac{Q}{BK}\right)^{\frac{1-\sigma}{\sigma}} \end{aligned} \quad (13)$$

Equation (13) suggests that an increase in mark-up squeezes both labour and capital shares. For labour share, I derive also the partial derivative:

$$\frac{\partial LS}{\partial \pi} = -\frac{\alpha}{\pi^2} \left(\frac{Q}{AL}\right)^{\frac{1-\sigma}{\sigma}} \quad (14)$$

Which asserts the negative correlation.

Finally, considering market imperfections in labour markets as well, I introduce the possibility of wage bargaining. Suppose real wage is determined as a weighted average:

$$\frac{W}{P} = \gamma \frac{Q}{L} + (1 - \gamma) W_r$$

where $0 \leq \gamma \leq 1$ is a measure of bargaining power of employees. When employers can single-handedly dictate labour market conditions, meaning $\gamma = 0$, the real wage equals some reservation wage $\frac{W}{P} = W_r$. On the other hand, if unions dominate the negotiation process, implying $\gamma = 1$, all the gains from increases in labour productivity accrue to wages, equivalently $\frac{W}{P} = \frac{Q}{L}$.

Taking account wage bargaining, labour share takes the following form:

$$\begin{aligned} LS = \frac{W}{P} \frac{L}{Q} &= \left(\gamma \frac{Q}{L} + (1 - \gamma) W_r \right) \frac{L}{Q} = \gamma + (1 - \gamma) W_r \frac{L}{Q} \\ &\Rightarrow \begin{cases} LS = 1, & \text{if } \gamma = 1 \\ LS = W_r \left(\frac{L}{Q} \right), & \text{if } \gamma = 0 \end{cases} \end{aligned} \quad (15)$$

Translated to words, equation (15) implies that the greater the bargaining power of unions, the closer the labour share is to one (or 100%, when speaking in percentages).

All in all, the selected model provides four important lessons for the mechanisms determining the labour share. These can be read from equations (11), (12), (14) and (15), and for convenience I offer a brief summary. The relation between capital-labour ratio, labour-saving technology and the labour share is tied to the elasticity of substitution. If the elasticity is below unity, an increase in the former has a positive effect on labour share, while the latter's impact is negative. In case the elasticity is above unity, the exact opposite applies. In comparison, accumulation of monopoly power always decreases labour share, while accumulation of bargaining power works the other way. In the empirical section, I show that the complete model can explain the patterns of Finnish labour share in industry during the last hundred years quite coherently.

5 Methods

I use linear regression as my principal method to examine the relationships between labour share and its suggested determinants. Linear regression is a conventional way to approximate a linear connection between variables. It is based on the calculation of best linear fit through minimizing the sum of squared differences between the observed and fitted values, or i.e. the sum of squared *residuals*.

A crucial assumption considering regression based on observables is, that the error term is uncorrelated with the independent variables, stated formally as $E(\epsilon|X) = 0$. In social sciences, this assumption is often violated, since the determinants researchers are interested in are rarely randomly assigned. Consequently, the regression coefficients turn out biased.

Instead of the simplest cross-sectional regression, the core of my analysis is based on another regression technique including also time dimension, called the fixed effects -regression or shortly FE. FE has certain advantages over a cross-sectional setting: instead of relying on controlling all the relevant determinants, FE controls for time-invariant entity-specific variables and time-varying common shocks by construction.⁹⁶ This allows me to focus on controlling merely time-varying and entity-specific variables. Formally, FE-model can be expressed as:

$$Y_{it} = \gamma_i + \lambda_t + \beta X_{it} + \epsilon_{it},$$

where Y is the dependent and X is the independent variable. γ_i captures the entity-fixed effects and λ_t the time-fixed effects. Informatively, the above turns out to be algebraically the same as:

$$Y_{it} - \bar{Y}_i = (\gamma_i - \bar{\gamma}_i) + (\lambda_t - \bar{\lambda}) + \beta(X_{it} - \bar{X}_i) + (\epsilon_{it} - \bar{\epsilon}_i)$$

Where $\gamma_i - \bar{\gamma}_i = 0$, since the average over a constant is equal to the constant itself⁹⁷, meaning that the entity-fixed effects are effectively eliminated. Moreover, $\lambda_t - \bar{\lambda}$

⁹⁶Stock and Watson 2015, p. 396.

⁹⁷Here, $\bar{\gamma}_i = \frac{1}{T} \sum_{t=1}^T \gamma_i = \gamma_i$.

captures the impact of common shocks, ergo time fixed effects.⁹⁸

5.1 Econometric models

I begin my analysis at the most aggregate level, examining time series for industry as a whole. My time series model takes the following form:

$$\begin{aligned}\Delta \ln ALS_t = & \beta_0 + \beta_1 \Delta \ln density_t + \beta_2 \Delta \ln \left(\frac{K}{L} \right)_t + \beta_3 \Delta TFP_t \\ & + \beta_4 \Delta \ln \left(\frac{trade}{GDP} \right)_t + \beta_5 \Delta \ln \left(\frac{A\&D}{GDP} \right)_t + \beta_6 \Delta \ln \left(\frac{exp}{GDP} \right)_t \\ & + \beta_7 \Delta \ln NX_t + \epsilon_t,\end{aligned}\tag{16}$$

where ALS is the adjusted labour share, $density$ is the union density, $\frac{K}{L}$ is the real capital stock per employee, TFP is the total factor productivity, $\frac{trade}{GDP}$ is the ratio of imports plus exports to GDP, $\frac{A\&D}{GDP}$ is the ratio of foreign assets and debts to GDP, $\frac{exp}{GDP}$ is the ratio of public expenditure to GDP, and NX is the nominal exchange rate.

The aggregate approach has itself some clear advantages: it allows me to study the impact of certain variables that vary only at the level of the whole economy. In equation (16) these would be the last three, namely nominal exchange rate, public expenditure and foreign assets and debts. Considering the earlier literature around the determinants of labour share in Finland, especially the first is of great interest. In several occasions, devaluations are named as if not the principal, at least a major driver of the labour share in Finnish economy.⁹⁹

To relax the possibility of spurious regression in time series analysis caused by autocorrelating variables, I follow the conventional precaution of working with the first differences of logarithmic variables.¹⁰⁰ While taking logarithms makes the error terms more likely to follow a normal distribution, first differencing terminates the

⁹⁸Angrist and Pischke 2009, p. 223; Stock and Watson 2015, pp. 406–408; Wooldridge 2016, pp. 435–438.

⁹⁹See for example Pekkarinen and Vartiainen 1993.

¹⁰⁰Except for TFP, which is expressed as the usual growth rate in decimal form.

autocorrelation of variables with unit roots.¹⁰¹

In order to take advantage of a cross-sectional dimension, I use panel data of 11 industrial branches. The baseline panel regressions in my analysis can be formally expressed as:

$$\begin{aligned} \ln ALS_{it} = & \beta_0 + \gamma_i + \lambda_t + \beta_1 \ln density_{it} + \beta_2 \ln \left(\frac{K}{L} \right)_{it} \\ & + \beta_3 \Delta TFP_{it} + \beta_4 \ln \left(\frac{trade}{GVA} \right)_{it} + \epsilon_{it} \end{aligned} \quad (17)$$

$$\begin{aligned} \ln ALS_{it} = & \beta_0 + \gamma_i + \lambda_t + \beta_1 \ln density_{it} + \beta_2 \ln \left(\frac{K}{L} \right)_{it} \\ & + \beta_3 \Delta TFP_{it} + \beta_4 \ln \left(\frac{M}{GVA} \right)_{it} + \beta_5 \ln \left(\frac{X}{GVA} \right)_{it} + \epsilon_{it} \end{aligned} \quad (18)$$

In specifications (17) and (18), the independent variables are familiar picks in previous literature, but also consistent with my theoretical model. While capital-labour ratio appears in the model itself, TFP is meant to capture the effect of labour efficiency, referring to parameter A . Union density aims to represent the bargaining power of labour, and its theoretical counterpart is the model parameter γ . Trade can plausibly work through two channels: if its effect on product markets is dominating, trade can be seen as diminishing the mark-up parameter π , resulting in growing labour share. In case trade's impact works mainly through labour markets, it is squeezing the bargaining power γ , leading to decreasing labour share. In other words, I expect trade to behave according to the excess profit hypothesis. In chapter 7, I show, why this is a justifiable premise.

In addition to the baseline specifications, I will replicate the regressions using FD-estimators, working with log differences over five years.¹⁰² Using long differences allows me to encapsulate the long-term effects better, but I will also explore the more conventional FD-estimators of log differences over a single year. For sensitivity analysis, I check whether using weighted least squares or including branch-specific

¹⁰¹See e.g. Stock and Watson 2015, p. 607; Greene 2000, pp. 776–778.

¹⁰²Using long differences or "low-frequency variation" (D. Autor and Salomons 2018, p. 24) is a desirable technique, since more often than not the feedback between two variables does not take place within a 12-month window. For applied examples, see Graetz and Michaels 2018 and D. Autor and Salomons 2018.

trends affects the results¹⁰³, as well as changing the outcome variable from adjusted labour share to net adjusted labour share or simple wage share. To distinguish between the underlying mechanisms, I am to disaggregate the outcome variable, and test how the independent variables affect real wages and gross value added *per se*.¹⁰⁴ Finally, to ensure that my hypothesis testing is not invalidated by serial correlation, I rerun the baseline regressions using the recommended Wild cluster bootstrap standard errors, which are discussed in length in section 5.2.

5.1.1 Estimating the elasticity of substitution

In case the assumption of perfect markets is satisfied, the sign of the correlation between the labour share and capital-labour ratio reveals whether the elasticity of substitution, σ , is below or above one. In contrast to majority of previous empirical work, I am to ease the perfect markets assumption and interpret the coefficient on capital-labour ratio based on an estimate for the elasticity of substitution.¹⁰⁵ For example, in case the estimated elasticity turns out to be 1, as in Cobb-Douglas production function, any deviation in $\frac{K}{L}$ ratio's coefficient from zero is interpreted a sign of imperfect competition: negative coefficient implies excess profits, and positive suggests featherbedding in the labour markets, which means that wage rate is set above marginal productivity due to pressure from the unions.

While there are multiple ways of deriving an estimate of σ , the most straight-forward manner is bringing equation (6) to estimable form:

$$\ln \left(\frac{w}{r} \right)_{it} = \beta_0 + \gamma_i + \lambda_t + \beta_1 \ln \left(\frac{K}{L} \right)_{it} + \epsilon_{it}$$

where ϵ is an error term. Blanchard, for example, has followed this fashion and reports an average elasticity of substitution close to one for OECD countries during

¹⁰³Like Graetz and Michaels 2018, I control for branch-specific trends by adding $N - 1$ branch dummies to a long difference model. Since I am using differences, this is sufficient to isolate branch-specific trends: see Wooldridge 2010, p. 375.

¹⁰⁴Angrist and Pischke remark, that disaggregating the dependent variable is one way to test the causal pathway of interest (Angrist and Pischke 2015, p. 196). For an applied example, see Acemoglu et al. 2014, pp. 397–399.

¹⁰⁵Raurich, Sala, and Sorolla 2012, p. 184.

1961–1995.¹⁰⁶ In Finnish setting, Ripatti and Vilmunen and Jalava et al. apply a more versatile approach while both report an elasticity estimate around 0.4–0.6 after WWII.¹⁰⁷

Because of the desirable simplicity, I follow Piketty’s method and define the elasticity of substitution as:

$$\ln r_{it} = \beta_0 + \gamma_i + \lambda_t + \beta_1 \ln \left(\frac{K}{Y} \right)_{it} + \epsilon_{it} \quad (19)$$

where r_{it} is the rate of return in branch i at period t , and $\frac{K}{Y}_{it}$ is the capital-output ratio at market value in branch i at period t .¹⁰⁸ Since β_1 represents the marginal effect of $\left(\frac{K}{Y} \right)_{it}$ on r_{it} , our parameter of interest, the elasticity of substitution, is simply $\sigma = \left| \frac{1}{\beta_1} \right|$. Like Piketty, I compute the rate of return as:

$$r_{it} = \frac{CS_{it}}{\frac{K}{Y}_{it}} \quad (20)$$

where capital share comes from $CS = 100 - ALS$ and accounts the income of self-employed by construction.¹⁰⁹ Other variables are the same as in equation (19).

5.2 Restrictions and robustness

First of all, it is necessary to point out that the selected methodology provides at best *descriptive evidence* about the connection between labour share and the variables in question. While FE-regression can have a causal interpretation, this requires strong assumptions which are most likely not satisfied in this application. The critical assumption is that the dependent variable in treatment and control groups would have had a similar trend absent the treatment.¹¹⁰ Simply put, treatment and control groups, here, branches, must work as plausible counterfactuals to each other. At this level of aggregation, this is most likely a false hope.

¹⁰⁶O. J. Blanchard, Nordhaus, and Phelps 1997, pp. 97–99.

¹⁰⁷Ripatti and Vilmunen 2001, p. 36; Jalava, Pohjola, et al. 2005, abstract. Furthermore, Pohjola argues that the elasticity in Finland is probably below one. Pohjola 1995, pp. 559–560.

¹⁰⁸Piketty 2016, pp. 199–200.

¹⁰⁹Following from the fact that the income of self-employed is included in ALS (see section 3.1).

¹¹⁰Angrist and Pischke 2015, pp. 178–187.

Another important and distinctive restriction considering FE-models is the so called pooling restriction. It refers to the implicit assumption that the effect of the independent variables to labour share is identical across observation units, or formally, $\beta = \beta_i$. This quite heroic assumption is often ducked by stating that the regression coefficients must be interpreted as the *average* impact across heterogenous observation units, which I emphasize in this study as well.¹¹¹

Third problem threatening my empirical strategy is the probability of *serial correlation*, which must be addressed with length. Serial correlation refers to a phenomenon where past shocks show persistence.¹¹² This corrupts the independence of subsequent observations within clusters: observations appear to be artificially close to each other, which in most settings makes the corresponding residuals and therefore also the standard errors downward biased.¹¹³ Consequently, the conventional hypothesis testing turns invalid.

A general fix to address serial correlation is clustering the standard errors. Clustering allows serial correlation within clusters and eliminates the problem in a commonplace microeconomic setting.¹¹⁴ However, the setting of this thesis is not exactly commonplace, since the length of the panel is so long and the width is relatively small.¹¹⁵ Thus, it is quite likely that clustering will not provide the adequate fix.¹¹⁶

Another more efficient but also costlier way to deal with serial correlation is the bootstrap standard error. Bootstrap offers an alternative way to compute the standard errors, when the usual formula is not believed to produce good approximations of the actual sample variance of the estimator in question. In bootstrapping the trick is to create a large amount of random pseudosamples from the original sample, equal in size. Next, an auxiliary OLS estimate, $\hat{\beta}_b$, is computed for each pseudosam-

¹¹¹Azmat, Manning, and Reenen 2007. Criticism: Böckerman and Mika Maliranta 2012. The interpretation in the end: Stockhammer 2009.

¹¹²In practice serial correlation emerges when a time-varying and entity-specific omitted variable is autocorrelated. If e.g. unemployment rate happened to affect the changes in labour share within branches, it could cause the residuals to be autocorrelated, given that unemployment rate is probably an autocorrelated variable. See Stock and Watson 2015, 412–413.

¹¹³A Colin Cameron and Douglas L Miller 2015, pp. 6–7; Angrist and Pischke 2009, pp. 315–319.

¹¹⁴Angrist and Pischke 2015, p. 207.

¹¹⁵In relevant literature, this is often referred appropriately as the small N , large T -problem.

¹¹⁶The severity of serial correlation was made known by Bertrand, Duflo, and Mullainathan 2004, who address the problems and solutions in admirable detail.

ple. The resulting bootstrap standard error, $bse(\hat{\beta})$, is then the sample standard deviation of these auxiliary OLS estimates. Formally:

$$bse(\hat{\beta}) = \left[(B-1)^{-1} \sum_{b=1}^B (\hat{\beta}_b - \bar{\hat{\beta}})(\hat{\beta}_b - \bar{\hat{\beta}})' \right]^{\frac{1}{2}}, \quad (21)$$

where B is the number of pseudosamples.¹¹⁷ The strength of the bootstrap lies in its ability to take account the unorthodox distribution of data when the empirical model involves persistent variables.¹¹⁸ In this thesis, I am to use two variations of bootstrap standard errors: the block bootstrap and the Wild cluster bootstrap. With the former the idea is the same as with the standard bootstrap introduced above, but resampling is done over entire clusters – here, branches. In my case, the Wild cluster bootstrap is otherwise similar to the block bootstrap, except that instead of resampling over clusters of Y_{it} , it draws clusters of both $Y_{it} = X'_{it} + \hat{e}_{it}$ and $X'_{it} - \hat{e}_{it}$ with probability 0.5.¹¹⁹ Wild cluster bootstrap has proven to produce especially reliable standard errors in Monte Carlo settings. Cameron et al. and Brewer et al. show that using placebo treatments in a test of nominal size 0.05 the traditional clustered standard error fails to reject the null hypothesis at a rejection rate over 0.20 with 5 to 10 clusters, while Wild cluster bootstrap achieves a rejection rate around the optimal 0.05.¹²⁰

Finally, I discuss two topics that might bias the regression coefficients (instead of standard errors) themselves, namely *simultaneity* and *omitted variable bias*. More often than not, especially in macroeconomic contexts, there is a possibility that the variables of interest are in endogenous relation. This implies that there exists reverse causality or that the variables are determined simultaneously. Considering the models described above, the most probable candidates suffering from simultaneity are the capital-labour ratio and union density. With capital-labour ratio the potential of simultaneity is evident since the number of employees appears in the definition

¹¹⁷In the following analysis, I use 500 pseudosamples whenever bootstrapping is applied.

¹¹⁸Wooldridge 2016, pp. 203–204; Angrist and Pischke 2009, p. 300.

¹¹⁹Angrist and Pischke 2009, p. 301; A. Colin Cameron, Gelbach, and Douglas L. Miller 2008, p. 427.

¹²⁰A. Colin Cameron, Gelbach, and Douglas L. Miller 2008, pp. 422–425; Brewer, Crossley, and Joyce 2018, pp. 6–7. For a thorough discussion on robust inference with few clusters, see A Colin Cameron and Douglas L Miller 2015.

of labour share as well. As for union density, the incentive to join a union is arguably dependent of the position of labour with respect to capital, in another words the labour share. Simultaneity might bias regression coefficients in FE-models. I tend the issue merely by using lagged regressors, which at least ease the threat of simultaneity that takes place instantly.¹²¹

Omitted variable bias occurs when a variable Z which is excluded from the regression is correlated with the treatment variable X and the outcome variable Y , conditional on covariates. Consequently, the respective regression coefficient, β_X , will be biased. The direction of the bias depends on the signs of the correlations. In case an omitted variable is positively correlated both with the outcome and the treatment, the regression coefficient is upward biased by definition.¹²² Judging by the theoretical model in chapter 4, and previous research, one serious candidate for an omitted variable is monopoly power. For example, Autor et al. argue that a markable increase in monopoly power in the U.S. during couple past decades goes hand in hand with technological advancement, i.e. the two are positively correlated.¹²³ While monopoly power is presumably negatively correlated with the labour share, this would imply a negative omitted variable bias for the coefficients of $\frac{K}{L}$ and TFP .

¹²¹This is a precaution Böckerman and Maliranta apply as well. Böckerman and Mika Maliranta 2012, p. 269.

¹²²Angrist and Pischke 2015, pp. 71–92; Angrist and Pischke 2009, pp. 59–64.

¹²³D. Autor, Dorn, F. Katz, et al. 2017, pp. 23–26.

6 Data

6.1 Aggregate

For labour share in whole industry, which requires series of GVA, NVA, wage sum, employers' social contributions, number of employees and self-employed, my data is simply aggregated from the eleven branches in the branch-level dataset. Their sources are described in section 6.2. The aggregated series represent industrial production perfectly from 1960 onwards, but before that they exclude the relatively minor rubber and leather industry due to data difficulties. The underlying problems are addressed in detail in section 6.2.

Speaking of determinants of labour share, technology is proxied with the capital-labour $\left(\frac{K}{L}\right)$ ratio and total factor productivity (TFP). Like the variables composing labour share, capital stock is also aggregated from the branch-level stocks. To arrive at per capita numbers I divided the capital stock with the employment series described above. TFP is expressed simply as the Solow residual, A , which is derived from the Cobb-Douglas production function, written in log differences:

$$\Delta \ln Y = \Delta \ln A + \alpha \Delta \ln K + (1 - \alpha) \Delta \ln L, \quad (22)$$

where Y is output, K is capital, L is labour, and α and $1 - \alpha$ their respective shares of total income. Rearranging terms, I get

$$\begin{aligned} \Delta \ln Y &= \Delta \ln A + \alpha \Delta \ln K + \Delta \ln L - \alpha \Delta \ln L \\ \Delta \ln A &= \Delta \ln Y - \alpha \Delta \ln K - \Delta \ln L + \alpha \Delta \ln L \\ \Delta \ln A &= \Delta \ln Y - \Delta \ln L - \alpha(\Delta \ln K - \Delta \ln L) \\ \Delta \ln A &= \Delta \ln \left(\frac{Y}{L}\right) - \alpha \Delta \ln \left(\frac{K}{L}\right) \end{aligned} \quad (23)$$

Finally, exploiting the approximation $\Delta \ln \approx \% \Delta$ where $\% \Delta$ refers to the usual growth rate, I end up with

$$\% \Delta A = \% \Delta \left(\frac{Y}{L}\right) - \alpha \% \Delta \left(\frac{K}{L}\right) \quad (24)$$

Now, substituting Y with the real GVA at 2010 constant prices, K with the real net capital stock at 2010 constant prices, L with the number of employees and α with the average of capital share in periods t and $t - 1$, I exploited equation (24) to acquire series of yearly change in TFP, expressed in percentage points.¹²⁴

The idea of using capital-labour ratio as a proxy of technological change lies in an assumption that new capital always embodies some technological advancement. This is intuitive, if one were to think of new machinery and equipment: they certainly are acquired with hopes of upgrading production technology. Strictly speaking, capital-labour ratio is meant to capture how well labour can be substituted with capital, as explained in section 2.2. In contrast, total factor productivity pursues to measure technological improvement while keeping capital and labour input constant, and as such it works as an indicator for changes in input efficiency. Since I am presuming that TFP works as a valid indicator for *labour*-saving technological change, I am hoping that it could pin down exactly how good is the upgraded technology at saving work effort, frankly, automating it.

Considering my study, the long time period sets some unavoidable restrictions on the choice of indicator variables. Technological change cannot be proxied with ICT capital at the beginning of the 20th century for obvious reasons. Series on R&D investment might be feasible, but are very hard to come by. Fortunately, $\frac{K}{L}$ ratio and TFP are among the two of the most common measures for technological change in my line of research and possible to compute based on sufficiently reliable sources. Essentially, in a research period of 100 years, the indicator variables need to have a sensible interpretation regardless of the evolution of time and massive changes in the means of production.

As an indicator of state intervention I decided to use public spending as a share of GDP. Until 1974 public spending is acquired from Hjerppe and from 1975 to 2015 from the modern national accounts (NA 1975–2015).¹²⁵ Here, no linking has been conducted. Public spending is meant to catch, for example, whether statutory changes in employers' social contributions can affect the labour share. It works also indirect ways: widening the social network of welfare state, by e.g. increasing

¹²⁴For the derivation of equation (24), see e.g. Pohjola 1996, p. 75.

¹²⁵Riitta Hjerppe 1988a; Official Statistics of Finland (OSF) n.d.(d).

unemployment benefits, should appear as an upward push in public spending. While this makes the outside-option of working more attractive, it might decrease the supply of labour and via that increase the reservation wage.¹²⁶

To measure globalisation I use the traditional trade share and a little more uncommon variable, the value of external assets and liabilities as a share of GDP. For trade share, expressed simply as $\frac{\text{imports} + \text{exports}}{\text{GDP}} \times 100$, I have data only for the imports and exports of goods, which of course oversees a vital part of trade, the services. The variable is constituted as a weighted average of import and export exposures by branch. A detailed description of the included branches is available upon request. External assets and liabilities are somewhat trickier to collect and consequently come from various sources. From 1890 to 1913 the data is provided in Bärlund,¹²⁷ and from 1914 to 1939 in Lappalainen.¹²⁸ For the war years I have used the crude estimates in Bärlund and Bärlund, along with partial linear interpolation in 1941–1943 and 1945–1949.¹²⁹ In 1950–1974 I have used the series in Airikkala & Sukselainen, and in 1975–1992 the series in Kariluoto.¹³⁰ Finally, the years 1993–2001 and 2002–2006 are from *Finland's balance of payments*, and the remaining years from 2007 to 2015 from Statistics Finland's financial accounts.¹³¹

After addressing technological change, my choices of indicator variables are relatively straight-forward. In order to indicate the impact of globalisation, trade share is single-handedly the most common proxy among related empirical work. The value of imports and exports are also relatively easy to access, both on aggregate and branch level, and are constructed with commendably uniform sources and methods. The idea behind external assets and debts is to provide a measure of capital mobility, in contrast with the circulation of goods: while the stock of non-domestic assets and debts grows, this can be seen as a signal of cross-border capital movement.

The last dimension of labour share determinants, bargaining power, I proxy with union density and strike activity. From 1907 to 1992 the former is computed as

¹²⁶ *Labour Losing to Capital: What Explains the Declining Labour Share?* 2012, p. 144.

¹²⁷ Bärlund et al. 1992.

¹²⁸ Lappalainen 1997.

¹²⁹ Bärlund 1945; Bärlund 1951.

¹³⁰ Airikkala and Sukselainen 1976; Kariluoto 1996.

¹³¹ Bank of Finland 2003; Bank of Finland 2007; Official Statistics of Finland (OSF) n.d.(a).

a weighted average of respective union densities by branch. After 1992, however, the mergers of a few key unions make the aggregation on the basis of industrial breakdown practically impossible, and therefore the union density for whole industry is approximated with the changes in union density in food etc., paper and metal industry. Working days lost due strikes from 1909 to 2015 is a simple aggregated sum from the branches in the branch-level dataset. The raw series is made comparable over time by expressing it as strike days per thousand employees.

Considering the bargaining power of employees, union density is a natural choice. It is popular in applied work and possible to collect from a long time span based on reliable materials. The justification is simple: while increasing part of employees acquire union membership, their guardian of interest, the union, grows more powerful. The union can combine the fragmented voices of single employees and organize them, for example, to strikes, which makes a bigger union a more notable actor for employers, enhancing their bargaining position. Strike activity mirrors the bargaining positions similarly working as a threat for employers and giving the employees leverage in wage bargaining.

On top of the classical theory explanations, it is necessary to contemplate about the idiosyncratic features of Finland as a case. After WWII, the regular devaluation of markka on every ten years or so came to be known as a quick fix to restore the profitability of export industries, and at the same time fix the distribution of income to “normal levels”, ergo depress the labour share. This cyclicity in the nominal exchange rate, inflation and functional income distribution was titled by the contemporaries as the devaluation cycle. I attempt to capture the impact of devaluations with the nominal effective exchange rate, which is collected from two different sources: for years 1862–1990 the data is from Autio,¹³² and from then on from Eurostat. Eurostat’s series are constructed on the basis of 24 trading partners from 1990 to 1993 and of 42 trading partners from 1994 to 2015.¹³³

¹³²Autio 1992, p. 236.

¹³³Eurostat 2017.

6.2 By branch

Disaggregated data by branch is a much scarcer resource than the data considering the whole economy. Nonetheless, it is necessary to bring the examination at branch level, since averaging and aggregation waste valuable information. In this thesis, I study labour share determinants with and unbalanced panel dataset of 11 branches practicing industrial activities for maximum of 156 years. Missing values in different variables materialize so that I have around 400 to 1300 observations in my analysis, depending on specification. I decided to focus on industrial branches as observation units because of relatively the best data quality and availability. Needless to say, this places some considerable restrictions on the external validity of my results.

For any data series which pursue to cover longer time periods, classification problems arise. For a period as long as 100 years my data fitting difficulties have been relatively secondary. As an initial framework I have exploited the industrial classification used in the first Growth study.¹³⁴ To begin with, I decided to leave leather and rubber industry out of my examination because of the inconsistencies caused by classification reforms. Therefore, leather industry joins in 1960 with the textile industry and the rubber industry tags along with the chemical industry.

As the primary data source in my panel, I use Bank of Finland's Growth studies. They cover the most constitutive series of gross value added (GVA), wage sums and employment from 1860 to 1959. From then on I use the data in *National accounts. Timeseries for 1960–1981 (NA 1960–1981)* from 1960 to 1974, and the modern NA from 1975 to 2015.¹³⁵

Considering globalisation and bargaining power, my branch-level data sources are the following: The value of exports and imports in 1860–1949 comes from the Growth studies,¹³⁶ in 1950–2001 from various volumes of foreign trade statistics (FTS),¹³⁷ and in 2002–2015 from the Uljas database. The value of exports was kindly provided by Kasper Lavikainen.¹³⁸ The number of union members for union density I have

¹³⁴Reino Hjerpe et al. 1976, p. 21.

¹³⁵Heikkinen and Riitta Hjerpe 1986; Reino Hjerpe et al. 1976; Official Statistics of Finland (OSF) 1984; Official Statistics of Finland (OSF) n.d.(d).

¹³⁶Pihkala 1969; Oksanen and Pihkala 1975.

¹³⁷Official Statistics of Finland (OSF) n.d.(b).

¹³⁸Exported goods have been assigned to the eleven branches following the solutions made by

collected from Yli-Pietilä in 1907–1988 and from *Statistical Yearbook of Finland* then on, except for the gap in data in 1989 which has been linearly interpolated.¹³⁹ Strike activity, measured here as strike days per thousand employees, is from *Statistical Yearbook of Finland* for years 1909–2015.¹⁴⁰

Proxies for technological change by branch have required the biggest effort in my data collecting process. While next to impossible to measure *per se*, indicators of technological change in historical data are not plentiful to say the least. Root of the problem is that branch-level series of real capital stock do not exist. To overcome this shortage I have constructed real net capital stock series for all 11 branches in my panel dataset from 1900 to 2015.

The capital stock series are composed of three different volume series. The last two are picked out from data provided by statistical officials in *Capital stock in Finland 1960–1981* (CSF 1960–1981) and the latest NA, spanning from 1960 to 1974 and 1975 to 2015, respectively.¹⁴¹ The earliest volume series for the whole industry are computed using the sum of real net capital stocks in mining, manufacturing and energy industries in Tiainen.¹⁴²

Note, that Tiainen provides capital stock series only for the whole industry. Next, it had to be assigned for eleven different branches, where my modest effort stepped in. I exploited the data of fixed assets by branch in industrial statistics for 1954–1959, the records of taxable wealth by branch in statistics of income and property for 1920–1952, and the indices of installed power by branch in Growth studies for 1900–1919.¹⁴³ My strategy was the following: I prioritized the data considering the

statistic officials. With regards to imports, only raw materials and accessories have been categorized to different branches in Pihkala 1969, Oksanen and Pihkala 1975 and Foreign trade statistics until 1997, i.e. investment goods were classified separately. From 1997 to 2015, investment has been included in the branch-level breakdown, as well (Foreign trade statistics 1998, Volume III, Tables 6a and 7). I have categorized two major subclasses of investment goods, namely machinery and apparatus and transport equipment excluding tractors, as imports of metal industry during 1860–1997.

¹³⁹Yli-Pietilä 1990, p. 62; yearly editions of *Statistical Yearbook of Finland* 1989–2015. The details on assigning unions to different industrial branches are available upon request.

¹⁴⁰Yearly editions of *Statistical Yearbook of Finland* 1909–2015.

¹⁴¹Official Statistics of Finland (OSF) 1988; Official Statistics of Finland (OSF) n.d.(d).

¹⁴²Tiainen 1994.

¹⁴³Official Statistics of Finland (OSF) n.d.(c); Official Statistics of Finland (OSF) n.d.(e); Heikkinen and Riitta Hjerpe 1986; Reino Hjerpe et al. 1976.

whole industry and used the above-mentioned sources just to define each branch's *proportion* of the total capital stock. The latter was done by taking the level of real net capital stock in CSF 1960–1981 for year 1960 as given, and then extrapolating this first with the records on industrials statistics, second with the numbers on statistics of income and property, and finally with the data in Growth Studies. I addressed the gaps in tax records with linear interpolation, for which the details are available upon request. Formally, each branch's proportion of the total capital stock per annum can be expressed as:

$$\frac{\widehat{K}_{i,t}^N}{\sum_{i=1}^{11} \widehat{K}_{i,t}^N},$$

where $\widehat{K}_{i,t}^N$ is the real net capital stock in branch i in year t , and the hats symbolize that the values are extrapolations.

The step-by-step composition of my branch-level capital series underwent as follows: first, I constructed a volume series of net capital stock in 1900–1960 for the whole industry by extrapolating backwards the real net capital stock according to CSF 1960–1986 in 1960 using Tianen's series. Second, I assigned this industry-level series for the eleven branches by multiplying it with each branch's respective proportion, $\frac{\widehat{K}_{i,t}^N}{\sum_{i=1}^{11} \widehat{K}_{i,t}^N}$. Third, I formed volume indices of the branch-level series and linked them to volume indices in 1960–1975 and 1975–2015 based on CSF 1980–1981 and NA 1975–2015. Finally, I set the base year of the linked branch-level indices to 2010, and created capital stock series at constant 2010 euros through multiplying the nominal value of real net capital stock in 2010 annually by $\frac{100}{\text{linked index}_t}$. The result was branch-level series of net capital stock at 2010 constant euros from 1900 to 2015.

Fortunately, the industrial classification used in industrial statistics and tax records is easily adjustable to the classification I am using, which is presented in the Growth studies. There is one exception, however, which is mining and quarrying. The tax records do not include taxable wealth for mining and quarrying before 1942, and consequently I have proxied its capital stock's development with the surplus branch in statistics of income and property from 1924 to 1942, which is tar, oil and rubber industry. The only resemblance with the two is tar manufacturing, which is included in mining and quarrying in Growth Studies, but other than that the two

depict quite different activities. Regardless of this, I am hoping that the trends are relatively similar.

Common to historical materials, in this case likewise, the further we go back in time the more unreliable data becomes. While the unmanipulated data of fixed assets in industrial statistics matches the records in CSF 1960–1981 quite well, considering tax records, the match is ultimately poorer.¹⁴⁴ The capital data in Growth studies is merely a measure of the amount of power the branch is exploiting, and thus, pictures the trend development of machinery and equipment at best, excluding industrial and other buildings. To summarize, the quality of my capital stock series deteriorates first in 1953 and second in 1920.

In an attempt to disentangle my independent variable in parts, I have also collected volume series of GVA. Volume of GVA in 1900–1959 is from Growth studies, in 1960–1974 from the NA 1960–1981, and in 1975–2015 from the modern NA. By applying the value and volume series for output and labour, I constructed a series of real unit labour costs. First, unit labour costs are acquired by dividing the labour costs, wages plus employers' social contributions, with labour input. As an indicator of labour input I used the number of wage earners in 1860–1959, and from then on the number of wage earners' working hours. Second, I simply deflated labour costs with the implicit GVA price index, which is itself computed as the ratio of value and volume indices.¹⁴⁵

Finally, in order to define capital-output ratio at market value, I used gross capital stock at current prices and GVA series from NA 1960–1981 and NA 1975–2015 from 1960 to 2015. Lacking older branch-level series of nominal gross capital stock, I extrapolated market valued capital-output ratio with a fixed priced proxy in 1900–1959, assuming that their development would be roughly similar. The latter I constructed using series of real net capital stock and real GVA described above.

¹⁴⁴While the stock of fixed assets in industrial statistics equals 110,7% of the net capital stock in CFS 1960–1981 in 1960 for whole industry, the stock of taxable wealth in statistics of income and property amounts merely 40,5% of the stock of fixed assets in 1954. However, the stock of taxable wealth is measured in 1952 while the stock of fixed assets is from 1954, which introduces some bias to this comparison.

¹⁴⁵Vattula 1980, pp. 13–14.

7 Analysis

7.1 Historical context and descriptive statistics

In this section, I will provide a parsimonious historical summary of the development of Finnish industry during the long twentieth century, relying on previous research and some descriptive statistics of my own data. I argue that despite my analysis cannot encompass the 19th century due to data limitations, extending the historical overview is well-grounded for better understanding of the starting point. By and large, the history of Finnish industry has been a massive success story in terms of economic growth, which is illustratively exemplified by the fact that after a relatively late initiation of industrialisation in around 1860s, industry's average labour productivity surpassed the level of the technological leader, the U.S., in 1996.¹⁴⁶ According to Hjerppe and Jalava, Finnish industry's most valuable assets have been a relative abundance in hydro power, forest resources and the surplus labour from agriculture.¹⁴⁷

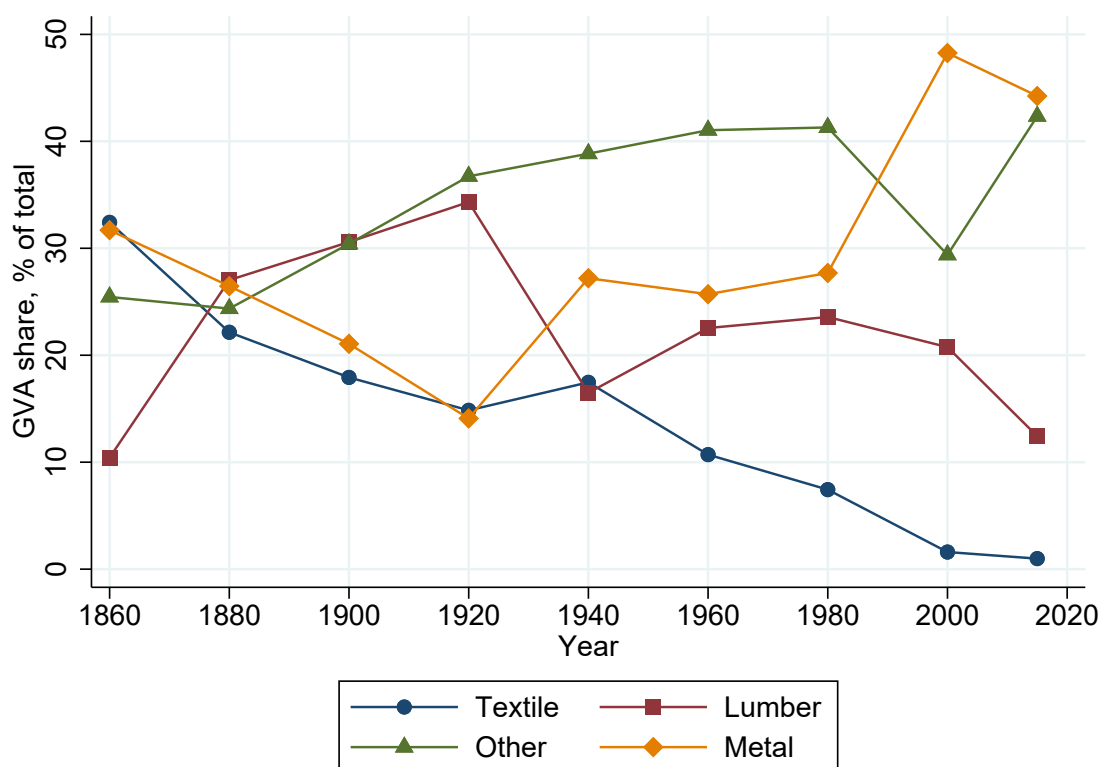
According to a common expression, Finland lives and breaths through her forests. While this is an exceptionally accurate simplification, it is somewhat inferior description of Finnish industry at the tails of the long 20th century. In the 1860s, the most important industrial branches in Finland were metal and textile industry in terms of shares in total gross value added, displayed in Figure 2.¹⁴⁸ Thereafter, paper and wood industry increased their relative weight, which they managed to maintain until WWII. The period around 1880 to 1930 was undoubtedly lumber industry's heyday, and considering exports the leadership lasted a lot longer. For the next four decades following WWII, both metal and lumber industry's GVA share was relatively stable, until in the 1980s metal industry finally took off, establishing its position as the biggest industrial branch: in 2015, metal industry covered over 40% of the total value added. The role of textile industry was to shrink in relative terms more or less continuously since the 1860s, while the gradual reduction of lumber industry began in the 1980s.

¹⁴⁶Jalava, Heikkinen, and Riitta Hjerppe 2002, p. 5.

¹⁴⁷Riitta Hjerppe and Jalava 2006, p. 35.

¹⁴⁸Heikkinen and Riitta Hjerppe 1986, p. 33.

Figure 2: GVA share in selected industries 1860–2015, % of total



Notes: The GVA share of lumber industry is the sum of the respective shares in wood and paper industry, while the GVA share of the surplus category "other" is the sum of GVA shares in all the other branches, namely mining, food etc., printing, chemical, non-metallic mineral, miscellaneous and energy industries.

Sources: Heikkinen & Hjerpppe 1986; Hjerpppe et al. 1976; NA 1960–1981; NA 1975–2015.

Despite lumber industry's decreasing importance in the more recent past, it rather unambiguously kickstarted the Finnish industrialisation process. A crucial milestone was allowing the use of steam power in saw mills in 1857 – steam was adapted quickly, and became the most important energy source in saw mills already in the 1870s.¹⁴⁹ The next major improvement in efficiency was the electrification of Finnish industry during the first half of the 20th century. The change's radical nature becomes clear when looking at electricity's share of total motive power in industry, which grew from

¹⁴⁹Ahvenainen, Pihkala, and Rasila 1982, p. 64.

7% to 90% in 1900–1939.¹⁵⁰ On top of the gains from electrification, paper industry experienced numerous technical upgrades during the interwar period, which elevated it temporarily to the largest industrial branch in the 1930s.¹⁵¹

The supply shock brought about by the war, reparations and a subsequent boom in Soviet trade was a breaking point in the competition between lumber and metal industry considering the race for the leading industrial branch.¹⁵² The shock also nudged metal industry towards heavier production. Another trajectory spurring heavier production was the increasing extent of value added in lumber industry, which boosted the demand for machinery.¹⁵³ From then on, metal industry began to concentrate more on investment and intermediate goods.¹⁵⁴ The transformation was partly sustained by the so called capital fundamentalism doctrine, a dominating philosophy of Finnish growth policy at least in the 1950s and the 1960s, which aimed to achieve a high investment rate via aggressive saving. The doctrine was successful: according to Pohjola, the investment rate in Finland was the highest in the world during 1960–1990.¹⁵⁵ Kiander and Vartia argue, that the investment-led growth strategy goes roughly hand in hand with president Urho Kekkonen's reign in 1956–1981. The president was a vocal proponent of the doctrine himself, and the centre-left coalition governments of his time willingly maintained the corporatist system, which ensured the doctrine's continuity.¹⁵⁶ Corporatism refers to the tripartite co-operation with the central organisations of both employers and employees and the state.

In the 1990s, the catch-up process of Finnish economy ran out of gas, timely portrayed by a heavy recession. Pohjola argues that the recession was actually an inevitable consequence of the excess capacity, a byproduct of the capital fundamentalism of the preceding decades.¹⁵⁷ The user cost of capital was consciously weighted down by policy, which led to overinvestment and labour hoarding.¹⁵⁸ Kyyrä and

¹⁵⁰Jalava 2007, p. 123.

¹⁵¹Ahvenainen, Pihkala, and Rasila 1982, pp. 224–245.

¹⁵²Ibid., pp. 319, 408.

¹⁵³Ibid., p. 430.

¹⁵⁴Ibid., pp. 421–422.

¹⁵⁵Pohjola 1996, pp. 14, 113.

¹⁵⁶Kiander and Vartia 1998, pp. 276–278.

¹⁵⁷Pohjola 1996, pp. 124–126.

¹⁵⁸Kiander and Vartia 1998, pp. 23, 288–310.

Maliranta show that over the recession the most profitable firms – characterised by low labour shares – managed to increase their market shares, while the least profitable had to exit the market.¹⁵⁹ As such, Kyyrä & Maliranta’s findings complement Pohjola’s narrative of ”excess capacity”, which was purged in a process of creative destruction. All the same, the break of the 1990s was labeled with numerous bankruptcies and mergers, demonstrating a necessary shift from extensive to intensive growth in Finnish industry.¹⁶⁰ Another topical feature of the era was growing exploitation of information and communication technology (ICT), which offered whole new opportunities to economize working hands.

Next, I delve into industry’s history in more detail, and examine it from the viewpoint of each potential determinant of the labour share. In terms of globalisation, the last 150 years are conventionally periodized into two waves, divided by an autarkic interwar era. Like Figure 3 suggests, the periodization applies roughly to Finnish industry, however, it encompasses more than mere volumes. Considering exports, the first wave of globalisation was indisputably wood and paper industry’s domination: combined the two covered the majority of total industrial exports most of the time, and by WWI the share rose above 80%. Sawmill products ranked as the most important group among export goods.¹⁶¹ Regarding imports, at the early phases of industrialisation their composition was more complementary than competitive when mirrored against domestic production.¹⁶² Apart from lumber industry, the other branches exploited mostly foreign raw materials,¹⁶³ what was encouraged because imported raw materials were tariff-free, in contrast to final products.¹⁶⁴ Around half of all imports went to food, beverage and tobacco industries. Import and export shares by branch are portrayed in Figure B5.

In between the two World Wars, Finnish trade policy turned inward along with the rest of the world.¹⁶⁵ Import tariffs approximately doubled, rising from circa

¹⁵⁹Kyyrä and Mika Maliranta 2006, pp. 18–19.

¹⁶⁰See e.g. Jalava 2007, p. 27 or Jalava, Heikkinen, and Riitta Hjerppe 2002, p. 4.

¹⁶¹Ahvenainen, Pihkala, and Rasila 1982, p. 64.

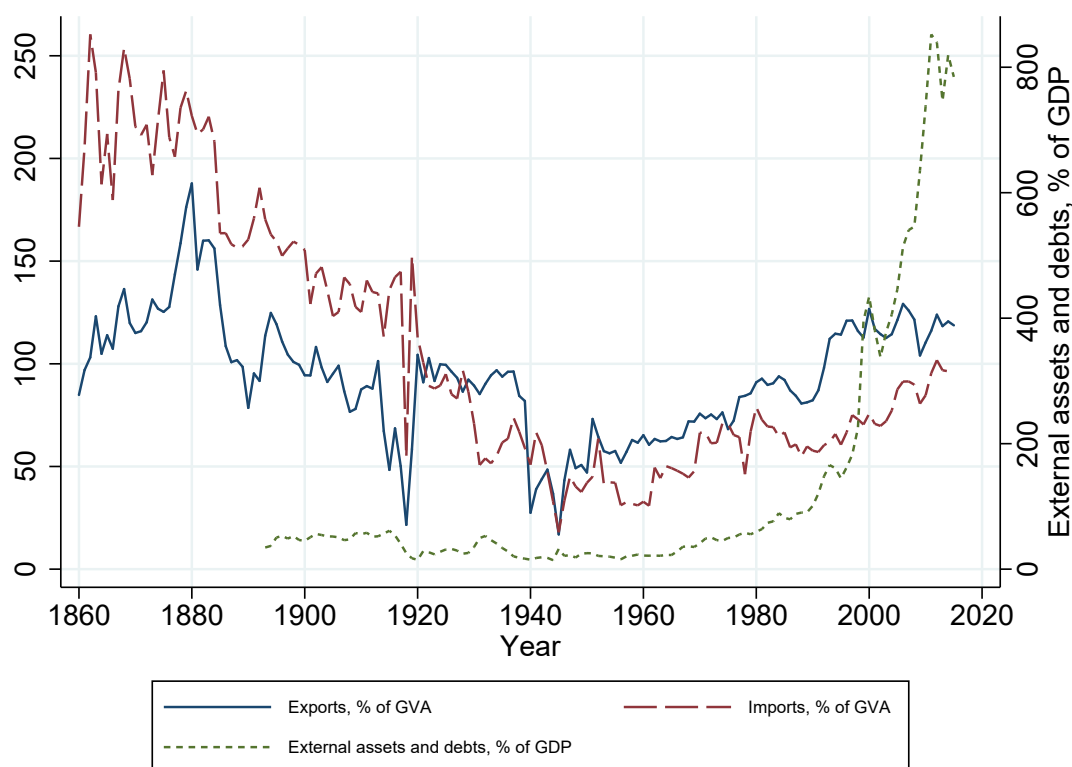
¹⁶²Riitta Hjerppe 1988b, p. 147.

¹⁶³Heikkinen and Riitta Hjerppe 1986, p. 53.

¹⁶⁴Ahvenainen, Pihkala, and Rasila 1982, p. 84.

¹⁶⁵Regarding the Finnish experience, see Oksanen and Pihkala 1975. For a global comparison, check Eichengreen 1995.

Figure 3: Exports, imports and external assets and debts 1860–2015, %



Sources: Exports and imports: Pihkala 1970; Oksanen & Pihkala 1975; Foreign trade statistics 1950–2001; Uljas database. External assets and debts: Bärlund 1992; Lappalainen 1997; Bärlund 1945; Bärlund 1951; Airikkala & Sukselainen 1976; Kariluoto 1996; *Finland's balance of payments 1993–02*, *Finland's balance of payments 1997–2006*, Financial accounts 2007–2015.

10% to 20% ad valorem in 1913–1938.¹⁶⁶ Exports turned more one-sided, as lumber industry became virtually the only exporter.¹⁶⁷ The replacement of sawmill products by chemical pulp as the main export illustrated the changing hierarchy within lumber industry in the 1930s. By the 1950s, chemical pulp was overtaken by newsprint.¹⁶⁸

During 1945–1957, foreign trade was still rationed and built upon bilateral agreements. The second wave of globalisation began to slowly evolve in the late 1950s in the form of trade deregulation and stepwise integration, yet it really accelerated

¹⁶⁶Riitta Hjerpe 1988b, p. 133.

¹⁶⁷Ahvenainen, Pihkala, and Rasila 1982, p. 229.

¹⁶⁸Riitta Hjerpe 1988b, pp. 143–144.

over the 1990s.¹⁶⁹ Important advancements in terms of deregulation include Finefta in 1961, which made Finland an associate member of the European Free Trade Association (EFTA),¹⁷⁰ as well as a free-trade agreement with the European Economic Community (EEC) in 1974.¹⁷¹ The acceleration of globalisation over the 1990s was partly due to joining the European Union in 1995, but mainly because of global factors, such as the foundation of the World Trade Organization (WTO) in 1995, the liberalisation of the Asian giants, China and India, during the passing decade, as well as the integration of Eastern Europe to the global economy after the Cold War.¹⁷² Looking at the composition of trade, in exports the share of lumber industry began to contract fast around the 1960s at the expense of metal industry, and to lesser extent, chemical industry.¹⁷³ In 2015, metal industry covered nearly 60% of total industrial exports, effectively doubling its share in comparison to the 1960s. Considering imports, the majority was also focused at metal industry. Chemical industry emerged as another noteworthy import branch over the later half of the 20th century. Altogether, the bundle of import goods became more competitive as of the mid-20th century, when trade barriers were abolished and the developing countries began to specialize in manufacturing products.¹⁷⁴

Despite the crucial role of steam in wood industry, it was only the second largest energy source after hydro power in the whole industry at the eve of WWI.¹⁷⁵ Speaking of technological change, the electrification of interwar years really catalyzed industrial production. Even now, the period from 1920 to 1938 stands out as an era of exceptionally rapid growth. It shows in TFP growth rates, displayed in Figure 4,¹⁷⁶ as well: in an average branch, TFP grew at a pace of 4.5% per year in 1920–1938,

¹⁶⁹Ahvenainen, Pihkala, and Rasila 1982, p. 370. Note the revision in the classification of imported and exported goods in 1974, which is responsible for the upward hike in import exposure in 1970. Foreign trade statistics 1974, Volume II, 10–12.

¹⁷⁰Jalava, Heikkinen, and Riitta Hjerpppe 2002, p. 9.

¹⁷¹Ahvenainen, Pihkala, and Rasila 1982, p. 374.

¹⁷²Haaparanta et al. 2017, pp. 23–24; Freeman 2009, p. 579.

¹⁷³Ahvenainen, Pihkala, and Rasila 1982, pp. 376–377.

¹⁷⁴In developing countries, the proportion of manufacturing goods of total exports increased from 10% to 65% in the latter half of the 20th century. See Findlay and O'Rourke 2009, pp. 513–514.

¹⁷⁵Ahvenainen, Pihkala, and Rasila 1982, p. 59.

¹⁷⁶For the relevant data and methodology, see chapter 6. As a robustness check, my estimate of TFP growth rate in whole industry during 1948–200, 3.67%, comes rather close to what Jalava et al. report for manufacturing during the respective period (3.80%).

compared to the annual average of 2.2% during 1900–2015. Furthermore, Jalava estimates, that approximately 33% of TFP growth in 1920–1938 can be attributed to electrification.¹⁷⁷ In many occasions, electricity provided for the first time ever a possibility to replace routine tasks carried out by brute muscle by simple machinery. It also sped up the introduction of the newest technology.¹⁷⁸

After WWII electrification had reached its peak, but industry kept growing rapidly. During the Golden years of 1947–1973, real GVA grew 7.1% per annum in an average branch, compared to staggering 10.8% in 1920–1938. TFP growth also slightly moderated, standing at 3.8%. A key factor behind the impressive growth performance was a shift from small-scale establishments to methods of mass production, an ongoing process in other European countries, as well.¹⁷⁹ Due to a sizeable gap to the technological frontier and the need for reconstruction, Finland was able to borrow technology and reorganize the means of production fast. Every fixed investment included years' amount of cumulated human investment, which saturated to growth rates.¹⁸⁰ The growing scale of production could be chased down to industrial handicraft's proportion of total industrial plants, which declined from circa 75% to just 40% during 1950–1972.¹⁸¹ An additional incentive for introducing mass production was the progress of European integration, which opened up markets for a growing supply.¹⁸²

In the next two decades the growth rate in industry toned down, with respect to both volume and TFP. From 1973 to 1990, real GVA grew 3.2% per year and TFP 2.0% per year. The changing trend followed the pattern of other European economies, and was probably because the gains of catch-up were wearing thin. Technology could no longer be copied, it had to be invented.¹⁸³ In consequence, factories sought efficiency improvements by downsizings and mergers, which increased markedly in

¹⁷⁷Jalava 2007, p. 116.

¹⁷⁸Riitta Hjerppe and Jalava 2006, p. 53.

¹⁷⁹Eichengreen 2007.

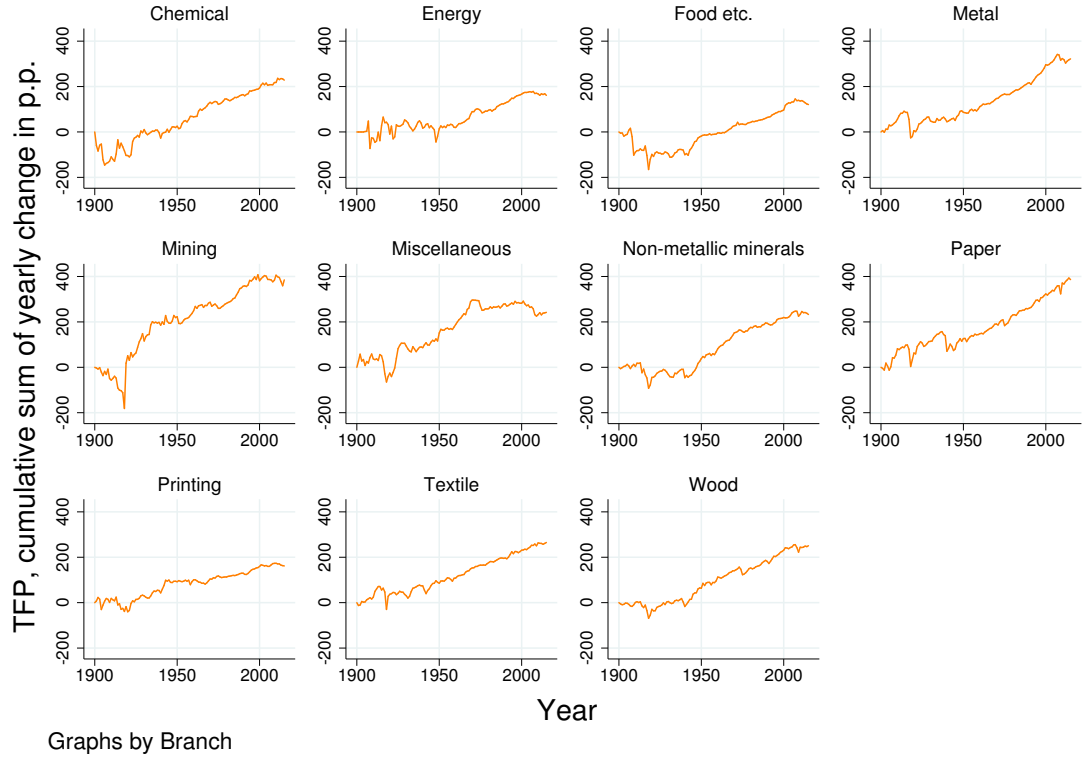
¹⁸⁰Jalava and Hjerppe note, that technological progress in Finland has relied typically on borrowing of technology. Riitta Hjerppe and Jalava 2006, p. 55. See also Myllyntaus 1992, p. 638.

¹⁸¹The shift to factories was particularly evident in metal, mining and food, beverage and tobacco industries. Ahvenainen, Pihkala, and Rasila 1982, pp. 410–430.

¹⁸²Eichengreen 2007, p. 38.

¹⁸³*Ibid.*, pp. 252–256.

Figure 4: TFP, cumulative sum of yearly change in percentage points 1900–2015, by branch



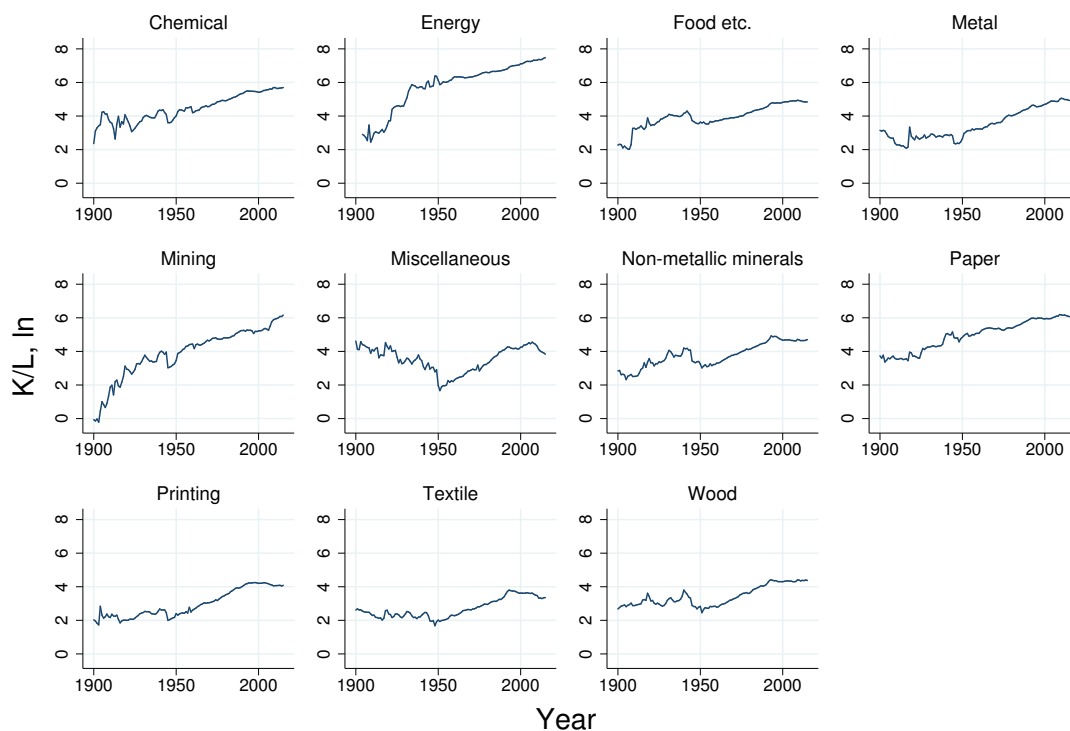
Sources: Author's own calculation: see section 6.1.

Finnish industry as of the late 1980s.¹⁸⁴ The reshuffling of production further intensified in the early 1990s, as Finland was hit by the worst recession of her economic history. On the upside, efficiency appeared to materialize in the years to follow, as TFP growth rate jumped to 3.3% in 1991–2007. It remains unclear, however, to what extent the increase can be attributed to business restructuring, since efficiency was simultaneously improved by the ICT boom. According to Pohjola, ICT's contribution to TFP growth rate from 1996 to 2005 was nearly 40% within the whole economy, while Jalava evaluates a contribution as high as 90% over the 1990s.¹⁸⁵ The flagship of ICT industry was the telecommunications company Nokia, which

¹⁸⁴Ojala and Karonen 2006, p. 110.

¹⁸⁵Pohjola 2017, pp. 468–469; Jalava 2007, p. 116.

Figure 5: Capital-labour ratios 1900–2015, by branch



Graphs by Branch

Notes: The variable is real net capital stock per employee at 2010 prices, in logs.

Sources: Author's own calculation: see section 6.2.

according to Asplund and Maliranta corresponded for over a quarter of the GDP growth rate at its peak in year 2000.¹⁸⁶

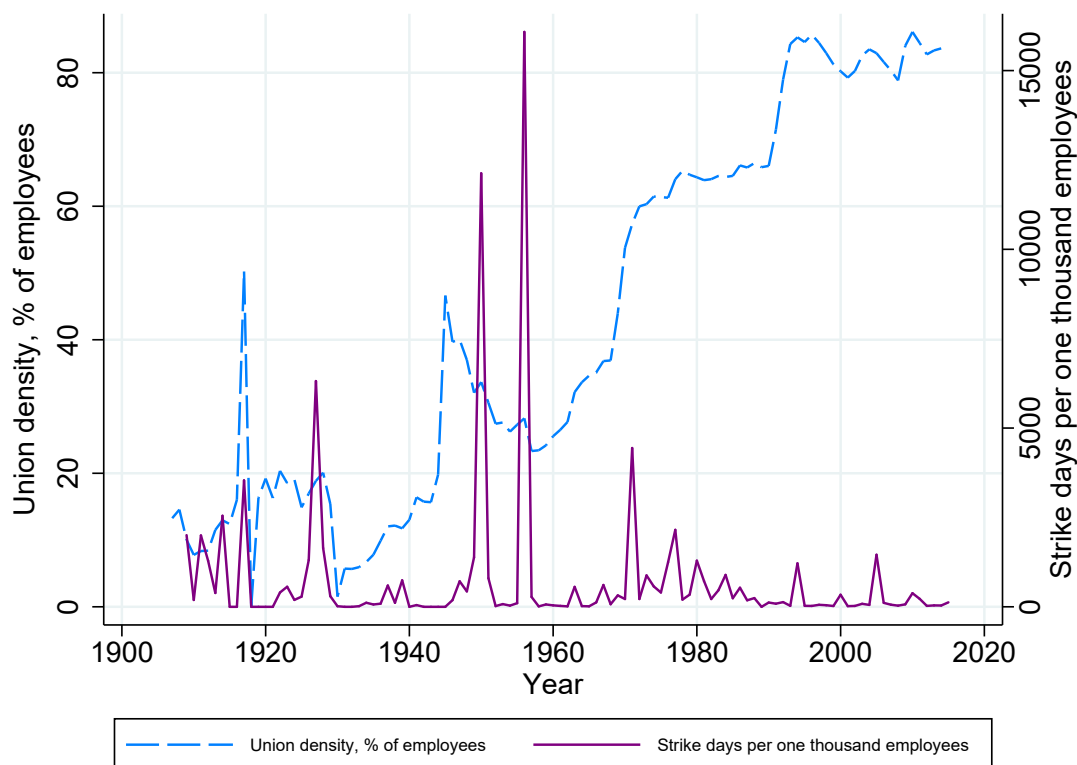
With respect to bargaining power, both employees and employers saw it wise to organize their operation in the 1880s, as the first workers' associations and trade unions were established.¹⁸⁷ The founding of central organisations, SAK and STK, took place in 1907.¹⁸⁸ Despite the emergence of necessary organs, only a minority of wage earners negotiated their wages in local collective agreements or via collective

¹⁸⁶Asplund and Maliranta 2007, p. 313.

¹⁸⁷Hannikainen and Heikkinen 2006, p. 171.

¹⁸⁸SAK was an employee organisation, known by the time as SAJ, while STK was an employer body.

Figure 6: Union density and strike days per one thousand employees in whole industry



Sources: Union members: Yli-Pietilä et al. 1990; *Statistical Yearbook of Finland 1989–2015*. Strike days: *Statistical Yearbook of Finland 1909–2015*. Employees: Heikkinen & Hjerppe 1986; Hjerppe et al. 1976; NA 1960–1981; NA 1975–2015.

bargaining in the early 20th century.¹⁸⁹ During the interwar years employers maintained an upper hand in the labour market. Class skirmish of the 1920s, partly a legacy of the bitter Civil War in 1918, culminated over the Great Depression as right-wing extremists pressured the parliament to close down "communist" organisations, including the Central Organisation of Trade Unions, SAK.¹⁹⁰

A few months after the closure, SAK was re-established, and during the 1930s also

¹⁸⁹Hannikainen and Heikkinen 2006, p. 172.

¹⁹⁰Regarding the labour market relations, see *ibid.* and Ojala and Karonen 2006. With respect to political turbulence, see Jussila, Hentilä, and Nevakivi 2009, pp. 152–154.

the political landscape stabilized.¹⁹¹ The necessity of co-operation during WWII wiped the slate clean considering labour market relations. In 1940, STK and SAK recognized each other as equal bargaining partners for the first time, in an event known as *tammikuun kihlaus*. Subsequently, union membership virtually exploded increasing union density threefold in 1943–1945, which shows vividly in Figure 6.¹⁹² After the war, Finland gradually began to practice a labour market policy which was grounded on collective wage agreements and occasional devaluations, together upholding cost competitiveness.¹⁹³

In 1968, the first national income policy agreement reinforced the status of corporatism in Finnish economic policy.¹⁹⁴ The 1968 agreement materialized simultaneously with another upsurge in union density at the turn of the 1970s, when SAK was unified after disputes of the preceding decade.¹⁹⁵ The latest disruption regarding labour market relations was the economic crisis of the 1990s, which convinced many that corporatism was an outdated system in a globalized world economy. Soaring unemployment and national debt made trade unions fall from favour with the general public, leading to a series of exceptionally moderate wage agreements, and stagnation of union density.¹⁹⁶ A concrete example of weakening unions was the prime minister Esko Aho's unforeseen attempt to reduce nominal wages in a so called 'new social contract', an epochal proposal despite it was not eventually implemented.¹⁹⁷

Finally, let us consider what is to be explained, referring to the development of the dependent variable in time. In Figure 7, we can see that industry as a whole experienced a sharp downward turn in labour share after the Civil War in 1918, during the Great Recession of the 1930s, and in the economic crisis of the 1990s.¹⁹⁸

¹⁹¹ Ahvenainen, Pihkala, and Rasila 1982, p. 184.

¹⁹² Ibid., pp. 358–361.

¹⁹³ Pekkarinen and Vartiainen 1993.

¹⁹⁴ Ibid., p. 285.

¹⁹⁵ Ahvenainen, Pihkala, and Rasila 1982, pp. 362–369.

¹⁹⁶ Sauramo 2016. Notice, that the peak in union density during 1990–1993 in Figure 6 is merely a cyclical phenomenon, resulting from a sharp drop in employment. From 1990 to 1993, the number of employees contracted by over a hundred thousand, while the number of union members remained virtually constant.

¹⁹⁷ Kiander and Vartia 1998, pp. 289–290; Kiander, Pekka Sauramo, and Tanninen 2011, p. 14.

¹⁹⁸ This observations was first made in Hannikainen and Heikkinen 2006, p. 173.

Remarkable upward hikes took place right after the WWII and, in somewhat lesser extent, during the latest economic crisis around 2010. Considering the overall trend, Kaldor’s hypothesis of stable shares can be outrightly rejected. In addition, Kuznets curve cannot give a satisfactory explanation to the observed pattern. It could be described as roughly accurate until the early 1990s, as labour share first has a tendency to fall in 1860–1943 and an aptness to grow in 1944–1991. The subsequent decline, however, breaks the curve’s explanatory power. Piketty’s emphasis on the turbulent decades in 1914–1945 earns the strongest visual support, yet it concerns exclusively WWII.

Descriptive statistics of all relevant variables in my aggregate level data are presented in Table 1, while the ones for panel data are reported in Table 2. Note, that I have trade data only for total of 8 branches. Union density is available altogether for 10 branches. Import and export exposure by branch as well as union density by branch are visualized in Figure B1 and Figure B2. Averages by branch can be found in Table B3.

Table 1: Descriptive statistics of aggregate data

	Observations	Mean	Std. Dev.
WS	156	48.2	5.3
LS	156	52.1	5.9
ALS	156	53.1	6.4
$NALS$	102	65.2	10.2
ΔTFP	115	2.2	8.1
$\frac{K}{L}$	116	81.7	66.1
$density$	108	42.8	28.1
$\frac{trade}{GVA}$	156	200.2	84.3
$\frac{M}{GVA}$	156	106.7	62.0
$\frac{X}{GVA}$	156	93.6	29.5
$strikes$	107	740.0	2085.9
$\frac{A\&D}{GDP}$	123	122.7	197.5
$\frac{exp}{GDP}$	156	14.8	8.0
$\frac{K}{Y}$	116	4.1	0.8
r	116	11.6	2.6

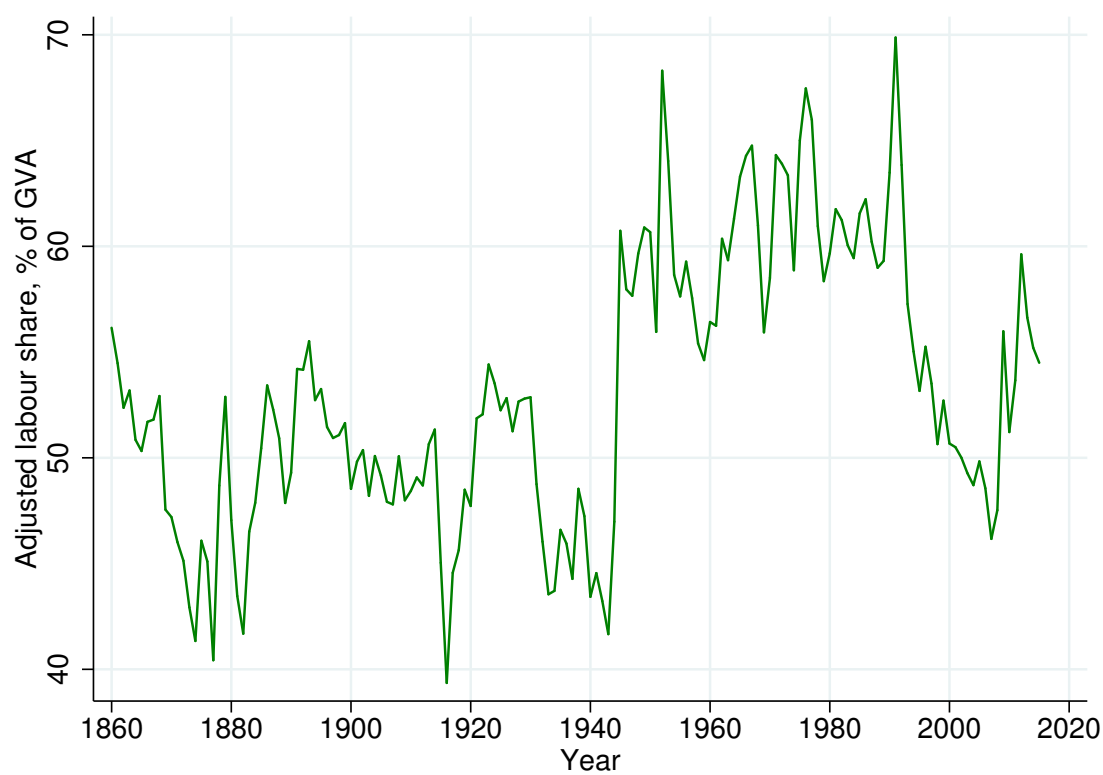
Note: WS is wage share, LS is labour share, ALS is adjusted labour share, $NALS$ is net adjusted labour share, TFP is the growth rate of total factor productivity, $\frac{K}{L}$ is real net capital stock per employee at 2010 constant prices, expressed in millions of euros, union density is union density, $\frac{trade}{GVA}$ is the sum of $\frac{M}{GVA}$ and $\frac{X}{GVA}$, where the former is the value of imports as a share of GVA and the latter is the value of exports as a share of GVA, $strikes$ is working days lost due strikes per one thousand employees, $\frac{A\&D}{GDP}$ is to foreign assets and debts as a share of GDP, $\frac{exp}{GDP}$ is public consumption as a share of GDP, $\frac{K}{Y}$ is capital-output ratio at market value, and r refers to rate of return on capital.

Table 2: Descriptive statistics of panel data

	Observations	Mean	Std. Dev.
<i>WS</i>	1715	50.3	15.7
<i>LS</i>	1715	54.3	16.2
<i>ALS</i>	1715	56.0	17.6
<i>NALS</i>	1122	66.9	20.3
ΔTFP	1261	2.2	15.1
$\frac{K}{L}$	1276	115.1	217.5
<i>density</i>	773	41.8	34.4
$\frac{trade}{GVA}$	1227	231.4	250.4
$\frac{M}{GVA}$	837	182.3	220.0
$\frac{X}{GVA}$	1167	112.6	136.4
<i>strikes</i>	1177	610.7	3019.2
$\frac{K}{Y}$	1276	5.0	4.2
<i>r</i>	1272	12.1	7.6

Note: *WS* is wage share, *LS* is labour share, *ALS* is adjusted labour share, *NALS* is net adjusted labour share, ΔTFP is the growth rate of total factor productivity, $\frac{K}{L}$ is real net capital stock per employee at 2010 constant prices, expressed in millions of euros, *density* is union density, $\frac{trade}{GVA}$ is the sum of $\frac{M}{GVA}$ and $\frac{X}{GVA}$, where the former is the value of imports as a share of GVA and the latter is the value of exports as a share of GVA, *strikes* is working days lost due strikes per one thousand employees, $\frac{K}{Y}$ is capital-output ratio at market value, and *r* refers to rate of return on capital.

Figure 7: Adjusted labour share 1860–2015, whole industry



Sources: Aggregated from branch-level data. For sources, see chapter 6.

7.2 Regression analysis

This section presents and discusses the results of my regression analysis. I begin the examination from the aggregate level, which equals time series analysis. Second, I analyse the branch-level data with panel regressions, including rich sensitivity analysis and disaggregation of the dependent variable. Third, I conclude the analysis section with additional robustness checks, which ensure that the main results are not biased by serial correlation.

Table 3 summarizes my time series analysis. It provides a first, yet crude glance to the determinants of labour share. The most explicit observation from Table 3 is, that the technology variables matter. Both TFP and capital-labour ratio come out with statistically significant and negative coefficients in numerous specifications at least at the 5% level: the former in all four, and the latter in all except one. Taking note of the other independent variables, one common feature is that they are all statistically insignificant, and not too different from zero. Trade share has a modest negative relation with labour share, which seems to be driven by export exposure. Nominal exchange rate has also the expected negative connection, which triples once I use a lagged regressor, but remains negligible even so. Curiously, foreign assets and debts and public expenditure are estimated to have adverse impact on labour share with respect to theory. Ultimately, union density's influence on labour share could be judged as non-existent.

Table 3: Results of time series analysis

	OLS			
	(1)	(2)	(3)	(4)
TFP	-0.43*** (0.15)	-0.40*** (0.14)	-0.42*** (0.15)	-0.41*** (0.14)
K/L	-0.35** (0.15)	-0.35** (0.15)	-0.23 (0.19)	-0.37** (0.16)
Union density	-0.00 (0.02)	-0.00 (0.01)	-0.01 (0.02)	-0.00 (0.01)
$\frac{trade}{GVA}$	-0.05 (0.05)			
$\frac{M}{GVA}$		0.01 (0.05)	0.02 (0.06)	0.01 (0.05)
$\frac{X}{GVA}$		-0.05 (0.06)	-0.05 (0.07)	-0.04 (0.07)
$\frac{A\&D}{GDP}$			0.04 (0.04)	
$\frac{exp}{GDP}$			-0.08 (0.08)	
NX			-0.01 (0.07)	
L1. NX				-0.03 (0.05)
Constant	0.02** (0.01)	0.02** (0.01)	0.02 (0.01)	0.02** (0.01)
<i>N</i>	105	105	105	105

Note: Dependent variable is the adjusted labour share. TFP is the growth rate of total factor productivity, K/L is the real net capital stock per employee at 2010 constant prices, expressed at thousands of euros, union density is the union density, $\frac{trade}{GVA}$ is the sum of $\frac{M}{GVA}$ and $\frac{X}{GVA}$, where the former is the value of imports as a share of GVA and the latter is the value of exports as a share of GVA, and strikes refers to the working days lost due to strikes per one thousand employees. All variables are expressed as log first differences, except for TFP, which is expressed as the annual growth rate in decimal form. Newey-West standard errors in parentheses.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Next, I extend my analysis to cross-sectional dimension. In the baseline models, I examine the determinants of labour share using panel data of eleven industrial branches. For starters, I have pictured the correlations between labour share and the main independent variables with scatter plots in Figure 8. Each scatter plot corresponds to a bivariate regression, where labour share works as a right-hand side and one of $\frac{K}{L}$ ratio, TFP, union density or trade share as the left-hand side variable. The scatter plots provide an explicit prediction for three variables, excluding TFP: $\frac{K}{L}$ ratio and trade share appear to be in negative relation with labour share, while union density's correlation appears to be positive. Of course, these are naïve comparisons, since the regressions include no controls. However, based on the smooth behaviour of the bivariate scatter plots the log-log functional form appears to be justifiable.¹⁹⁹

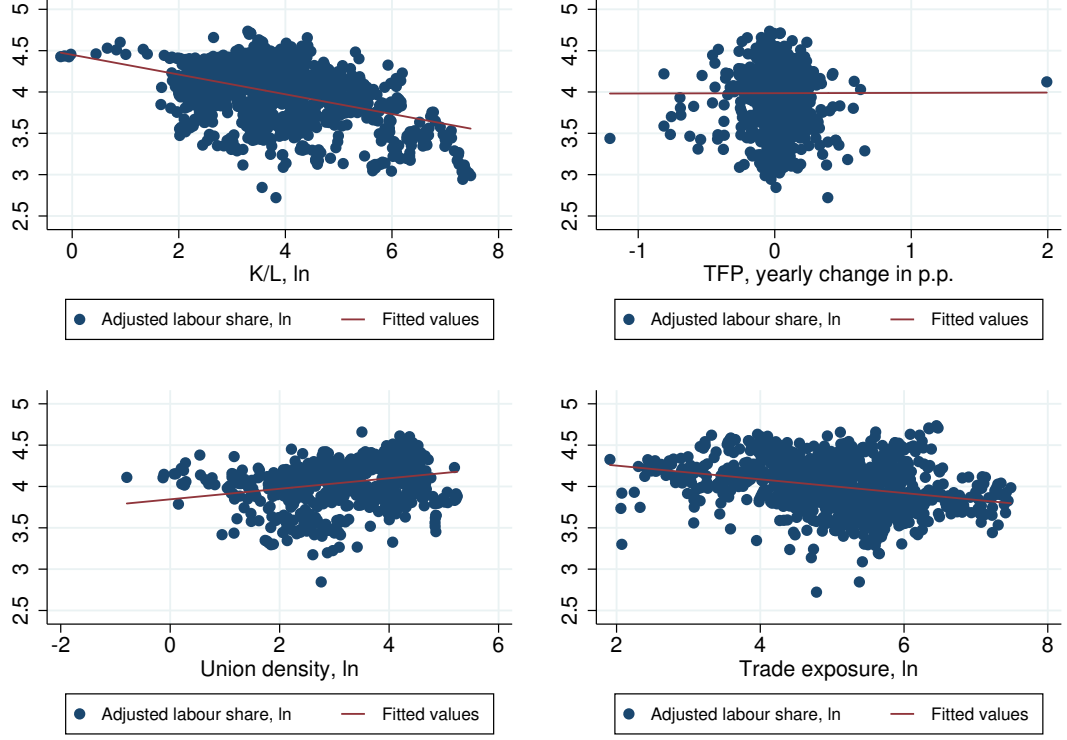
Table 4 reports the first set of panel regressions, including the baseline specifications. According to the preferred FE-models, the determinants of labour share get a bit more multifaceted compared to the time series analysis. First, TFP shows a robust negative correlation with labour share in different specifications. Similar to the time series analysis, the negative effect of $\frac{K}{L}$ ratio is established here, as well. However, it seems to be particularly sensitive to whether or not import rate is included to the regression. At the branch-level, union density appears to have a notable and robust, positive effect on labour share. Contradicting the visual suggestions in Figure 8, once conditioned on covariates, trade share's negative correlation with labour share turns positive, yet statistically insignificant. Intriguingly, once we separate trade into imports and exports they both show positive correlation with labour share, import share's impact being both sizable and robust.

Table 5 represents the baseline regressions using weighted least squares and five-year log differences. Comfortably, the results remain by and large the same as in Table 4. The magnitude of all coefficients except the one on import exposure appears to grow slightly when applying WLS. Intuitively, the WLS-estimators are more informative about the relative importance of each independent variable from the viewpoint of a single employee, since the regressions are weighted by the number of employees, while OLS-estimators tell the impact of each factor on a figurative average branch.²⁰⁰ The

¹⁹⁹ A similar argument is made in Graetz and Michaels 2018, pp. 19–20.

²⁰⁰ Angrist and Pischke 2009, pp. 40–41, 92.

Figure 8: Bivariate regressions between adjusted labour share and the main independent variables



Notes: Each dot corresponds to one of the eleven branches in a bivariate regression of the form $\ln ALS_{it} = \beta_0 + \beta_1 X_{it} + \epsilon_{it}$, where X is one of the four explanatory variables. The sample period for the technology variables is 1900–2015, for union density 1907–2015, and for trade share 1860–2015. The red lines represent the respective regression lines.

five-year FD-estimates are also in line with the baseline results, albeit they predict a larger effect from TFP, while the coefficient on import exposure turns imprecise.

A second round of sensitivity analysis is offered in Table 6. In the first two regressions, the five-year log difference specifications have been rerun using WLS. The latter two exert also long differences and include branch-specific trends. The main take-away from Table 6 is that the relations found in baseline regressions maintain robust, with one exception: import exposure's estimate is again imprecise. It seems that when examining long differences, the broadly defined trade exposure captures the positive impact from imports. Meanwhile, note that union density comes out

Table 4: Baseline regressions

	FE, OLS		
	(1)	(2)	(3)
TFP	-0.24* (0.13)	-0.19*** (0.05)	-0.26*** (0.04)
K/L	-0.13 (0.13)	-0.44*** (0.08)	-0.40*** (0.10)
Union density	0.20*** (0.06)		0.14*** (0.04)
$\frac{trade}{GVA}$	0.07 (0.05)		
$\frac{M}{GVA}$		0.12*** (0.05)	0.14*** (0.05)
$\frac{X}{GVA}$		0.08*** (0.03)	0.03 (0.02)
Strikes		0.00 (0.00)	
Constant	3.45*** (0.45)	4.30*** (0.20)	3.95*** (0.23)
Branch fixed effects	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes
Adj. R^2	0.54	0.62	0.72
N	588	374	388

Note: Dependent variable is the adjusted labour share. TFP is the growth rate of total factor productivity, K/L is the real net capital stock per employee at 2010 constant prices, expressed at thousands of euros, union density is the union density, $\frac{trade}{GVA}$ is the sum of $\frac{M}{GVA}$ and $\frac{X}{GVA}$, where the former is the value of imports as a share of GVA and the latter is the value of exports as a share of GVA, and strikes refers to the working days lost due to strikes per one thousand employees. All variables are expressed as log levels, except for TFP, which is expressed as the annual growth rate in decimal form. Block bootstrap standard errors in parentheses.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

statistically insignificant and the technology variables only marginally significant in specification (2). That said, the point estimates on all variables are comparable to earlier results, and the lack of preciseness is probably due to small sample size. In

Table 5: Baseline regressions, alternative specifications

	FE, WLS		5-year FD, OLS	
	(1)	(2)	(3)	(4)
TFP	-0.31** (0.13)	-0.32*** (0.04)	-0.50*** (0.10)	-0.43** (0.15)
K/L	-0.16 (0.14)	-0.43*** (0.12)	-0.24* (0.12)	-0.43** (0.18)
Union density	0.22*** (0.05)	0.16*** (0.05)	0.12*** (0.03)	0.13*** (0.03)
$\frac{trade}{GVA}$	0.03 (0.05)		0.09** (0.03)	
$\frac{M}{GVA}$		0.13** (0.05)		0.15 (0.08)
$\frac{X}{GVA}$		0.01 (0.02)		-0.03 (0.03)
Constant	3.77*** (0.48)	4.21*** (0.21)	-0.02 (0.10)	0.02 (0.18)
Branch fixed effects	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
Adj. R^2	0.58	0.76	0.44	0.47
N	588	388	102	63

Note: Dependent variable is the adjusted labour share. TFP is the growth rate of total factor productivity, K/L is the real net capital stock per employee at 2010 constant prices, expressed at thousands of euros, density is the union density, $\frac{trade}{GVA}$ is the sum of $\frac{M}{GVA}$ and $\frac{X}{GVA}$, where the former is the value of imports as a share of GVA and the latter is the value of exports as a share of GVA, and strikes refers to the working days lost due to strikes per one thousand employees. All variables in specifications (1) and (2) are expressed as log levels, except for TFP, which is expressed as the annual growth rate in decimal form. Specifications (1) and (2) have been weighted using each branch's average employment in 1907–2015. In specifications (3) and (4), all variables are expressed as log first differences over five years, except for TFP, which is expressed as the cumulative growth over five years in decimal form. Standard errors, which are block bootstrap in specifications (1) and (2) and clustered in models (3) and (4), in parentheses.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

specifications (3) and (4), regarding the inclusion of branch-specific trends, which is a strong control against time-varying omitted variables, the consistency of coefficients is quite reassuring. Overall, the impact of TFP is yet again estimated to be notably larger than in the baseline scenario.

Table 6: Baseline regressions, more alternative specifications

	5-year FD, WLS		5-year FD, OLS	
	(1)	(2)	(3)	(4)
TFP	-0.47** (0.13)	-0.44* (0.21)	-0.55*** (0.12)	-0.50** (0.19)
K/L	-0.26** (0.11)	-0.47** (0.19)	-0.26* (0.13)	-0.47* (0.20)
Union density	0.12*** (0.03)	0.12 (0.07)	0.13*** (0.03)	0.14*** (0.03)
$\frac{trade}{GVA}$	0.10** (0.03)		0.09** (0.03)	
$\frac{M}{GVA}$		0.16 (0.09)		0.16 (0.09)
$\frac{X}{GVA}$		-0.04 (0.03)		-0.04 (0.03)
Constant	0.08 (0.13)	0.15 (0.26)	-0.01 (0.10)	-0.01 (0.19)
Branch fixed effects	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
Branch-specific trends	No	No	Yes	Yes
Adj. R^2	0.42	0.48	0.42	0.44
N	102	63	102	63

Note: Dependent variable is the adjusted labour share. TFP is the growth rate of total factor productivity, K/L is the real net capital stock per employee at 2010 constant prices, expressed at thousands of euros, density is the union density, $\frac{trade}{GVA}$ is the sum of $\frac{M}{GVA}$ and $\frac{X}{GVA}$, where the former is the value of imports as a share of GVA and the latter is the value of exports as a share of GVA. All variables are expressed as log first differences over five years, except for TFP, which is expressed as the cumulative growth over five years in decimal form. Specifications (1) and (2) have been weighted using each branch's average employment in 1907–2015. Clustered standard errors in parentheses.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

To ensure that the found correlations are not sensible to the computation method of labour income share, I have rerun the baseline models from Table 4 using wage share and net adjusted labour share as an independent variable. In both cases, the results

change only trivially. To address the concern of instant simultaneity, I re-estimated the same models once more, using 3 and 5 year lags of union density and capital intensity. Again, the coefficients are comparable to the ones figured in Table 4. The robustness checks described here are gathered in Table B1.

As a reality check on my estimates I compare them to previous research. Considering the technology variables, the preferred baseline point estimates in Table 4 are below the ones presented in Hutchinson & Persyn: they estimate elasticities of -0.62 and -0.55 for TFP and $\frac{K}{L}$ ratio, while the respective numbers here are -0.26 and -0.40 .²⁰¹ Note, however, that Hutchinson and Persyn define capital-labour ratio as capital stock per labour input of low- and medium-skilled labour. In a more recent study, Autor and Salomons find a TFP elasticity closer to mine (-0.37) in a sample constrained to manufacturing.²⁰² The relationship between union density and labour share has often found to be statistically insignificant in empirical examinations, so the connection in this thesis is a deviation to the tradition.²⁰³ The only other statistically significant estimate is found in Stockhammer, which is, however, very similar in magnitude: Stockhammer calculates that a one percentage point increase in union density increases the labour share from 0.18 to 0.20 percentage points.²⁰⁴ Transformed into comparable units, my estimate predicts a 0.18 p.p. increase.²⁰⁵ The impact of trade on labour share is often proxied with plain trade share, which has yielded negative coefficients, in contrast to the analysis above.²⁰⁶ In a prominent study, Elsby et al. also find import exposure to have negative effect on labour share.²⁰⁷ In light of this evidence, my estimate is again a minor surprise. Yet when Autor et al. try to replicate Elsby et al.’s result, they find that at least Chinese imports have indeed a positive impact on labour share, which is established also in an IV-analysis, suggesting a causal relation.²⁰⁸

²⁰¹See Hutchinson and Persyn 2012, p. 32, and the preferred specification (4).

²⁰²D. Autor and Salomons 2018, pp. 28, 57.

²⁰³Bengtsson emphasizes the role of union power as a labour share determinant in Sweden, where the employer-employee relations have developed comparably to Finland. However, he is unable to establish the connection in an econometric analysis (Bengtsson 2014, p. 299)

²⁰⁴Stockhammer 2009, pp. 45–50, the preferred specifications (Table 9).

²⁰⁵ $\frac{\beta_{density} \overline{ALS}_{1900-2015}}{density_{1900-2015}} = \frac{0.142 \times 54.27}{42.78} \approx 0.18$

²⁰⁶Section 3.2.

²⁰⁷Elsby, Hobijn, and Şahin 2013, p. 42.

²⁰⁸D. Autor, Dorn, F. Katz, et al. 2017, pp. 24–25, 73.

Recall, that only the technology variables achieved statistical significance in the time series analysis, while union density and import exposure yielded coefficients of practically zero. The difference between time series and FE-estimates is curious, but not overly surprising. It could demonstrate a scenario, where density and imports inflict negative spill-over effects on other branches, which neutralize their positive within-branch impact. Another potential explanation for the discrepancy is, that the aggregate time series are just too crude to distinguish the comparatively smaller effects of union density and import exposure. Expressing the variables in log levels, instead of log differences, could also prove crucial. In Table B2, I have re-estimated the two baseline FE-specifications using 1-year log first differences, and at least with regards to union density, the coefficients are remarkably smaller. I prefer the baseline FE-estimates, since inference using a panel is arguably more efficient, and yearly differences are potentially insufficient to identify the true effect.

7.2.1 Interpretation and robustness

Union density's robust, positive impact on labour share could signify the fact that in Finland the density has been exceptionally high in international comparison, which has caused a pivotal difference considering bargaining power. In other words, the Finnish unions have been powerful enough to make their demands heard.²⁰⁹ Another possible interpretation is that in majority of previous studies the sample period has been too short to successfully account for the effect of unions on labour share.²¹⁰ Thus, there has not been enough variance in union density to pin down the actual effect: at least in Finland, the biggest change in density happens just after WWII. In samples which begin from the 1970s, or even the 1990s, there may not be enough information of the relation between density and the labour share, which increases the variance of OLS estimates and yields insignificant results. Finally, Finland's high coverage rate could turn out crucial: because of the long-lived centralized wage

²⁰⁹Union density's importance as a labour share determinant in Finnish environment matches the perception of Hannikainen and Heikkinen 2006.

²¹⁰Farber et al. point out, that union density's effect on inequality was at its largest during 1940–1970 in the U.S., since the composition of union members was uncommonly negatively selected at the time. Because unions successfully attracted relatively large amount of less educated employees and minorities, their impact on income distribution was consequently enhanced. Farber et al. 2018, pp. 4, 16–17

agreement system, unions can affect the wages of non-union-members, as well.²¹¹ Consequently, their impact on wages increases.

Reflecting the excess profit hypothesis, the positive impact of import exposure on labour share might be due to its negative impact on profits. The idea is the following: growing number of imports could enhance competitive pressure in a given branch and by cutting profits increase the share of labour. The positive coefficient on import share may, however, suffer from upward bias, as well. In one scenario, the growing volume of imports encourages businesses to outsource labour-intensive operations into cheaper environments abroad. While effectively handling the negative pressure on labour share with outsourcing, the kind of reorganisation described creates an artificial upward push on labour share.²¹²

Considering the other two variables, the interpretation of their coefficients demands more scrutiny. The complications arise from the fact that the effect of TFP and $\frac{K}{L}$ ratio depends on the elasticity of substitution between capital and labour. This interrelation was elaborated in chapter 4. Recall, that according to the theory model, TFP would have a negative impact on labour share in case the elasticity was below one. Moreover, if the elasticity was below unity, the model predicts a positive impact from $\frac{K}{L}$ ratio. The regressions, on the other hand, show a negative connection for both. To shed light on the inconsistency, I turn to estimate the elasticity.

For starters, I have estimated the elasticity of substitution in 1900–2015 using specification (19), reproduced here:

$$\ln r_{it} = \beta_0 + \gamma_i + \lambda_t + \beta_1 \ln \left(\frac{K}{Y} \right)_{it} + \epsilon_{it}$$

Omitting branch- and time fixed effects, the resulting equation is:

$$\ln r_{it} = \frac{3.614}{(0.267)} - \frac{0.897}{(0.128)} \ln \left(\frac{K}{Y} \right)_{it}$$

$n = 1262 \quad Adj.R^2 = 0.60$

²¹¹Since the late 1990s, the coverage rate has varied between 90% to 98% Pekka Sauramo 2012, p. 20.

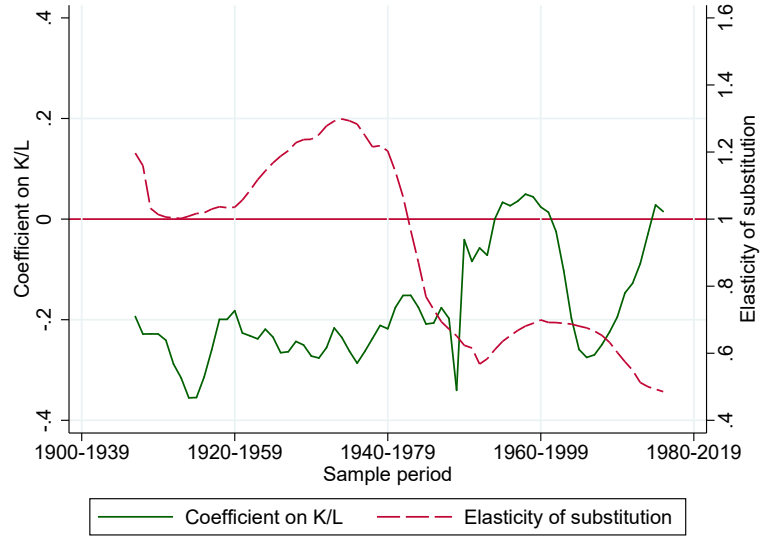
²¹²*Labour Losing to Capital: What Explains the Declining Labour Share?* 2012, p. 131.

Consequently, the long-term elasticity of interest is $\sigma = \left| \frac{1}{\beta_1} \right| = \frac{1}{0.897} = 1.11$.²¹³ The first thing to notice is, considering a standard error of 0.13, the elasticity does not differ significantly from one, which is the Cobb-Douglas case. However, since the point estimate is above one, a negative coefficient on $\frac{K}{L}$ ratio is indeed what one should expect, based on equation (11). So, a simple conclusion can be drawn: in the long-term, the interrelation between capital-labour ratio and labour share appears to fit the neoclassical model. Equivalently, the long-term determinant defining the interrelation is technology, instead of market power.

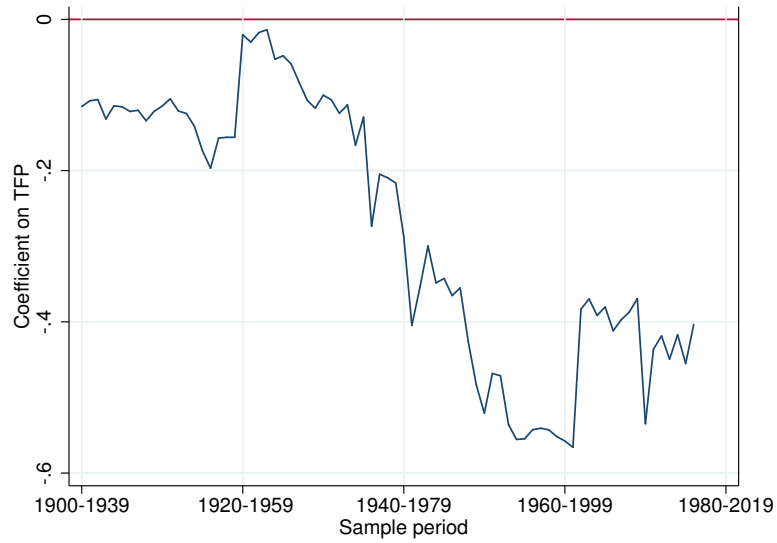
In light of the estimated long-term elasticity, TFP's negative coefficient remains an anomaly. Figure 9 pursues to disentangle it by graphing the parameters of interest over time. In Figure 9, the elasticity of substitution and coefficient on $\frac{K}{L}$ ratio from specifications (19) and (18) are estimated in a moving 40-year interval by applying the rolling regression. In rolling regression the above-said equations are solved repeatedly in an interval that shifts one year forward before each estimation. Thus, the sample period in the first regression is 1900–1939, in the second it is 1901–1940, and so on. TFP's coefficient in the bottom panel was estimated simultaneously with the one on $\frac{K}{L}$ ratio.

²¹³This is in line with Jalava et al., who report that a long run elasticity of one cannot be rejected in Finnish context. Jalava, Pohjola, et al. 2005, pp. 8–9.

Figure 9: Coefficient on capital-labour ratio and elasticity of substitution over time



(a)



(b)

Notes: Each line represents regression coefficients from rolling regressions with a regression window of 40 years. The elasticity of substitution is computed as $\left| \frac{1}{\beta_1} \right|$ from specification (19). The coefficients on $\frac{K}{L}$ and TFP come from specification (18). Values of zero for coefficients and one for the elasticity are denoted with red reference lines.

According to the predictions set out by the neoclassical model, elasticity of substitution and the coefficient on capital-labour ratio should follow an inverse relation. Specifically, if the elasticity is greater (smaller) than one, the coefficient should be negative (positive). Moreover, the elasticity and the coefficient on TFP ought to show a positive correlation: when the former is above (below) one, the latter ought to be positive (negative). These dependencies are based on equations (11) and (12), respectively. Figure 9 brings an empirical verification, for the most part, for both claims. In the upper panel, the sign on capital-labour tends to switch when the elasticity crosses the cut-off point of one. In addition, when mirrored against the bottom panel, the elasticity seems to correlate rather clearly with TFP's coefficient. However, two oddities stand out. First, the coefficient on TFP appears to be negative, despite the elasticity of substitution is above one in the earlier sample intervals. This could be due to either an upward bias in the elasticity or a downward bias in TFP's coefficient and does not necessarily invalidate the theory. Second, the elasticity and $\frac{K}{L}$ ratio's coefficient experience a meaningful discrepancy during the later sample intervals, that is, the inverse relation breaks. The discrepancy is most explicit around 1966–2005.

Based on the above observations, I derive another two conclusions: for one, technological change in Finnish industry could be described as labour-saving, rather than capital-saving.²¹⁴ For two, the negative coefficient on $\frac{K}{L}$ ratio is somewhat downward biased, and the bias is especially pervasive from 1966 to 2005. The first conclusion emerges from the good predictive power of the theory model, equation (12) in particular, presented in chapter 4. The second conclusion is based on the discrepancy, which signifies that the perfect markets assumption fails during the four decades preceding the Great Recession.

The sudden downward bias in capital-labour ratio's coefficient implies that the capital-owners possessed substantial market power at some point in 1966–2005. The attribute 'substantial' is based on the size of the discrepancy: against the estimated elasticity of hardly 0.7, the coefficient ought to be highly positive. In order to test this theoretical argument, I have pictured the development of two market power

²¹⁴The same conclusion was by Hjerpe and Jalava 2007. See Riitta Hjerpe and Jalava 2006, p. 56.

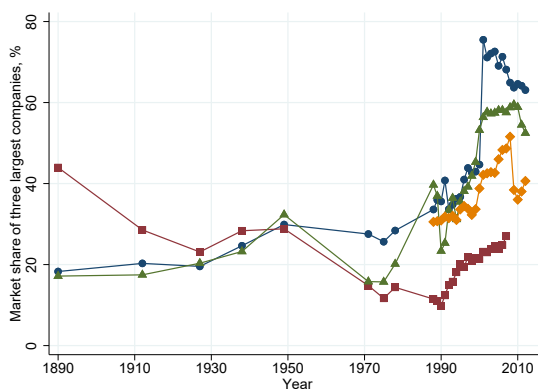
indicators from 1890 to 2012 in Figure 10. On the grounds of changes in market and employment shares of three largest businesses by industry, the employers have become remarkably more concentrated since the late 1980s.²¹⁵ To put the volumes in perspective, I compare them to analogous indicators in Autor et al. While in the U.S. the market share of *four* largest manufacturing companies hovered just below 44% in 2012, in Finland the arithmetic average of the largest *three* stood at 52%. In terms of employment, the analogous concentration ratios were more sensible, yielding circa 34% for the U.S. and 32% for Finland, but again, the setting is three against four.²¹⁶ In contrast, in EU the market share of four largest firms appears to have fallen after the break of millennia, standing approximately at 30% in 2012. This statistic, however, includes all industries.²¹⁷ Nevertheless, the two indicators provide rather strong reassurance to my interpretation, that the capital-owners enjoyed significant market power at some point from 1966 to 2005. To be more precise, the increase in market power appears to have realized from the late 1980s to mid-2000s.

²¹⁵The concentration resulted from an unforeseen wave of corporate acquisitions and mergers. See Ojala and Karonen 2006, p. 110 and Riitta Hjerpe 1988b, p. 74.

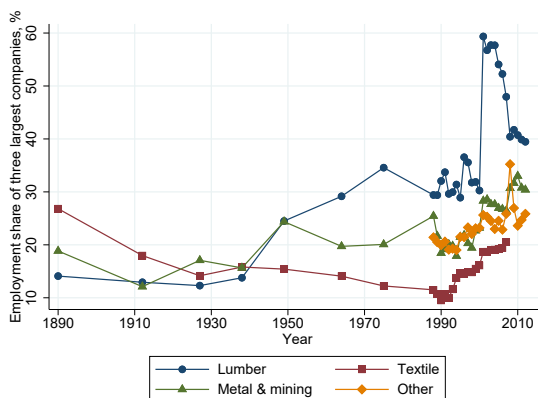
²¹⁶For the concentration ratios in the U.S., see D. Autor, Dorn, F. Katz, et al. 2017, p. 34.

²¹⁷The share is computed as a weighted average of 4-firm concentration ratios across industries, treating each country as a separate market. Therefore, it is roughly comparable to the numbers in Figure 10. See Gutiérrez 2017, p. 19.

Figure 10: Market and employment shares of three largest companies 1890–2012, by industry



(a)



(b)

Notes: The concentration ratio for markets is the sum of sales in the three largest companies as a share of gross value of production in a given industry. For employment, it is the sum of employment in the three largest companies as a share of total employment in a given industry. From 1988 onwards, branch-level data has been aggregated to the selected four industries as a weighted average by gross value of production or employment across branches.^a

Sources: Sales in largest companies: Hjerppe 1979; *Year-book of business in Finland* 1972, 1979. Market concentration ratio: Enterprises 1988–2012. Gross value of production: Heikkinen & Hjerppe 1986; *Statistical Yearbook of Finland* 1929, 1951, 1973; Industrial statistics 1938; NA 1975–2015. Employment in largest companies: Hjerppe 1979. Total employment: Heikkinen & Hjerppe 1986; Hjerppe et al. 1976; NA 1975–2015. Employment concentration ratio: Enterprises 1988–2012.

^aA method also followed by Gutierrez (2017): see Gutiérrez 2017, pp. 25–26.

The nature of each independent variable's relation with labour share is so far only speculative. Disaggregation of the dependent variable should bring some more light on the issue. Table 7 suggests that the technology variables' diminishing effect on labour share is due to mainly their push for economic growth. Another, equally truthful interpretation is that while technology boosts growth, the labour costs do not follow suit, which is demonstrated in specifications (3) and (4).²¹⁸ In fact, capital accumulation's relation with the real compensation of labour appears to be almost non-existent, conditional on covariates, based on specification (4). This gives additional weight to the suspicion that $\frac{K}{L}$ ratio's coefficient is downward biased due to market imperfections. Because of unknown rigidities, possibly economic rents, technological advancement does not saturate directly on wages. Union density has, as suspected, a positive pull on wages, but also a disturbing negative relation with the gross value added. The latter could reflect a scenario where unions manage to squeeze employers' profits over the wage bargaining process.²¹⁹ Imports' negative impact on output is in line with the scenario where imports boost labour share by reaping excess profits.

As discussed in section 5.2, as a last trial to the robustness of my results, I follow Cameron et al.'s recommendation and replicate the core of my analysis while applying Wild cluster bootstrap standard errors. The check is done to make sure that serial correlation has not biased the standard errors toward zero, leading to false rejections of the null. Turns out that the pass is close to perfect. In Table 8, all the robust correlations found in the baseline models remain statistically significant at least at the 5% level, except for TFP in specification (1), which is significant at the 12% level. This in mind, I account the results overall fairly solid.

²¹⁸Autor and Salomons report a similar result. They estimate a nominal-wage-TFP elasticity of 0.14 and a real-value-added-TFP elasticity of 0.92 in manufacturing. The analogous numbers here are 0.19–0.26 and 0.58–0.62, albeit the first elasticity is actually a real-wage-TFP elasticity. See D. Autor and Salomons 2018, p. 57.

²¹⁹In terms of the model in chapter 4, I propose that $\frac{K}{L}$ is positively correlated with the mark-up π , while union density is positively correlated with "union power" γ .

Table 7: Disaggregating the dependent variable: GVA and wages

	FE, OLS			
	(1) GVA	(2) GVA	(3) LC	(4) LC
TFP	0.61** (0.22)	0.56** (0.16)	0.19* (0.09)	0.26** (0.09)
K/L	0.81*** (0.19)	1.11** (0.36)	0.21* (0.10)	0.01 (0.10)
Union density	-0.40* (0.20)	-0.52*** (0.11)	0.12* (0.05)	0.11*** (0.01)
$\frac{trade}{GVA}$	-0.29 (0.23)		-0.05 (0.06)	
$\frac{M}{GVA}$		-0.58** (0.22)		-0.09** (0.03)
$\frac{X}{GVA}$		0.05 (0.04)		-0.06 (0.04)
Constant	10.91*** (1.29)	11.31*** (1.53)	0.24 (0.66)	1.27** (0.46)
Branch fixed effects	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
Adj. R^2	0.92	0.94	0.98	0.99
N	588	388	588	388

Note: Dependent variable in specifications (1) and (2) is the real GVA, while in specifications (3) and (4) it is the real labour cost. TFP is the growth rate of total factor productivity, K/L is the real net capital stock per employee at 2010 constant prices, expressed at thousands of euros, union density is the union density, $\frac{trade}{GVA}$ is the sum of $\frac{M}{GVA}$ and $\frac{X}{GVA}$, where the former is the value of imports as a share of GVA and the latter is the value of exports as a share of GVA. All variables are expressed as log levels, except for TFP, which is expressed as the annual growth rate in decimal form. Clustered standard errors in parentheses.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 8: Addressing serial correlation

	FE, OLS	
	(1)	(2)
TFP	-0.24 [0.11]	-0.26*** [0.00]
K/L	-0.13 [0.48]	-0.40*** [0.00]
Union density	0.20* [0.05]	0.14** [0.04]
$\frac{trade}{GVA}$	0.07 [0.32]	
$\frac{M}{GVA}$		0.14*** [0.00]
$\frac{X}{GVA}$		0.03 [0.56]
Constant	3.41** [0.03]	4.42*** [0.00]
Branch fixed effects	Yes	Yes
Time fixed effects	Yes	Yes
Adj. R^2	0.72	0.81
N	588	388

Note: Dependent variable is the adjusted labour share. TFP is the growth rate of total factor productivity, K/L is the real net capital stock per employee at 2010 constant prices, expressed at thousands of euros, density is the union density, $\frac{trade}{GVA}$ is the sum of $\frac{M}{GVA}$ and $\frac{X}{GVA}$, where the former is the value of imports as a share of GVA and the latter is the value of exports as a share of GVA. All variables are expressed as log levels, except for TFP, which is expressed as the annual growth rate in decimal form. P-values based on Wild cluster bootstrap standard errors in square brackets.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

8 Reflection

Considering the discovered marginal effects and the evolution of the elasticity of substitution between labour and capital, the overall evidence suggests that the big picture of Finnish factor shares is mainly a story of technological automation and shifts in the distribution of rents. In this section I will provide some additional weight to this scenario. I start by reflecting the results against the theory set out in chapter 4. Next, I compute some economic magnitudes. Finally, I pursue to periodize the development of labour share, discussing how the results compare to history.

Altogether, my interpretation of the empirical results is consistent with the theory model represented in chapter 4. At first glance, the technology variables' coefficients and the estimated elasticity of substitution appeared to contradict. However, in section 7.2 I demonstrated, that the contradiction was just a matter of timing: the negative coefficient on TFP was driven by post-WWII and the one on capital-labour ratio by pre-WWII period. Taking this into account, the estimated relationships were as expected based on equations (11) and (12). TFP's marginal effect was positively correlated and capital-labour ratio's marginal effect negatively correlated with the elasticity of substitution. There were anomalies, however: during the first half of the 20th century, increase in either TFP or $\frac{K}{L}$ ratio predicted a decline in labour share. I argue that the anomaly is modest and does not invalidate the model's overall good fit.

The discrepancy between $\frac{K}{L}$ ratio's coefficient and the elasticity from 1966 to 2005 was taken as a signal of increased monopoly rents. This conclusion was backed by a distinct increase in the market power of businesses, demonstrated in Figure 10. Theoretically, monopoly rents mark an increase in π , whereas equation (14) shows, that an increase in π predicts a decrease in labour share. Growth in union density would translate to an increase in γ , which implies an upward push for labour share, evident in equation (15). Considering import exposure, the observed positive correlation can be rationalized with imports' downward pressure on both power parameters π and γ , working through increasing competitiveness. In this case, the squeezing effect on monopoly power π seems to be dominating.

Considering the magnitudes of my estimates I offer a few practical examples. They focus on trajectories of the aggregate labour share apparent in Figure 7, trying to shed light on the most explicit trends, which I have nailed down to three: pre-WWII, post-WWII to the 1990s crisis, and post-1990s crisis. In Figure 11, I represent each variable's cumulative contribution on labour share during the respective period, taking the point estimates in my baseline specification at face value.²²⁰

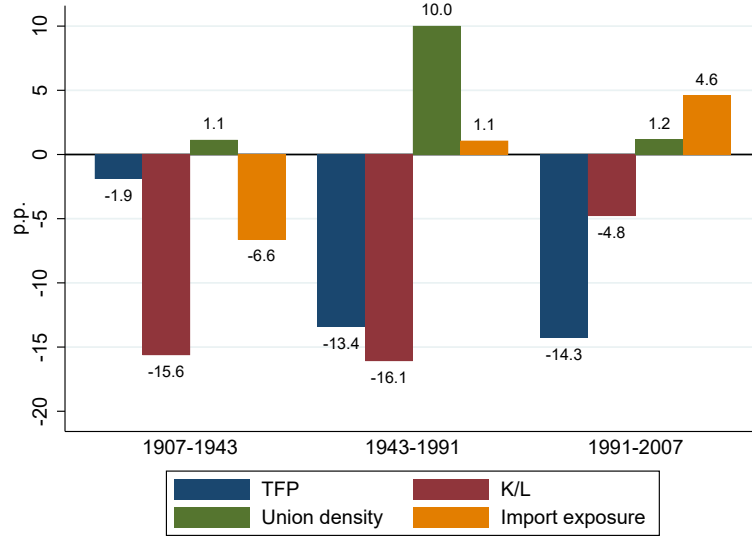
²²⁰For variables in logs, the cumulative contribution comes from $Y_{t_1} - Y_{t_0} = Y_{t_0} \frac{Y_{t_1} - Y_{t_0}}{Y_{t_0}} = Y_{t_0} \left[\left(\frac{X_{t_1}}{X_{t_0}} \right)^{\beta_X} - 1 \right]$, where the last term is solved from $\ln Y_{t_1} = \beta \ln X_{t_1}$ by first subtracting lagged equivalent from both sides, and then manipulating:

$$\begin{aligned} \ln Y_{t_1} - \ln Y_{t_0} &= \beta (\ln X_{t_1} - \ln X_{t_0}) \Rightarrow \ln \left(\frac{Y_{t_1}}{Y_{t_0}} \right) = \ln \left(\frac{X_{t_1}}{X_{t_0}} \right)^{\beta} \\ \Rightarrow \frac{Y_{t_1}}{Y_{t_0}} &= \left(\frac{X_{t_1}}{X_{t_0}} \right)^{\beta} \Rightarrow \frac{Y_{t_1} - Y_{t_0}}{Y_{t_0}} = \left(\frac{X_{t_1}}{X_{t_0}} \right)^{\beta} - 1. \end{aligned}$$

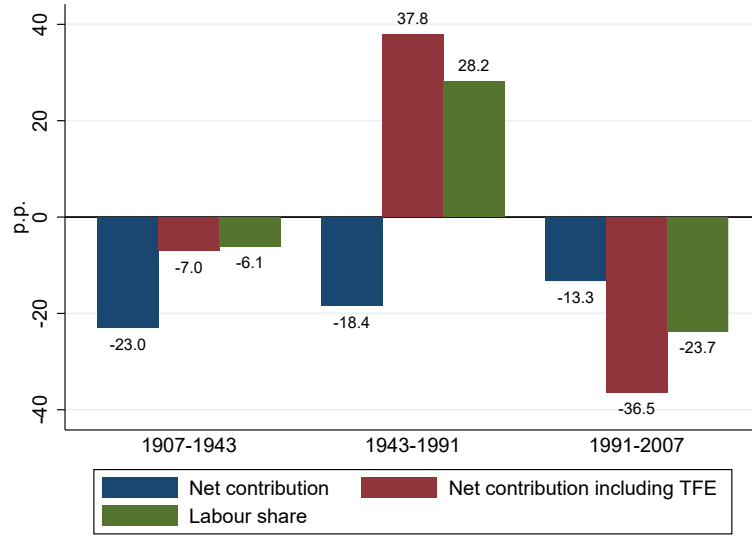
For TFP, the cumulative contribution is $Y_{t_0} [\exp(\beta_X \Delta X) - 1]$, which is similarly solved from

$$\begin{aligned} \ln Y_{t_1} - \ln Y_{t_0} &= \beta (X_{t_1} - X_{t_0}) \Rightarrow \ln \left(\frac{Y_{t_1}}{Y_{t_0}} \right) = \beta \Delta X \\ \Rightarrow \frac{Y_{t_1}}{Y_{t_0}} &= \exp(\beta \Delta X) \Rightarrow \frac{Y_{t_1} - Y_{t_0}}{Y_{t_0}} = \exp(\beta \Delta X) - 1. \end{aligned}$$

Figure 11: Contributions of explanatory variables on labour share



(a)



(b)

Notes: Each bar represents the cumulative contribution of a variable in question to labour share under the respective period. For variables in logs, i.e. $\frac{K}{L}$, union density and import exposure, the cumulative contribution is computed as $Y_{t_0}[\left(\frac{X_{t_1}}{X_{t_0}}\right)^{\beta_X} - 1]$, where β_X is the regression coefficient on variable X and Y_{t_0} is the adjusted labour share at the start of the respective period. For TFP, the cumulative contribution is $Y_{t_0}[\exp(\beta_X \Delta X) - 1]$. The coefficients come from specification (18), which is the baseline model. The cumulative change of each variable is calculated based on the aggregate series.

Before WWII labour share was overall at low levels compared to the mean of the century. It experienced distinct drops over WWI and after the Great Depression, of which the latter proved to be a prolonged state. The total decline from 1907 to 1943 equalled 6.1 percentage points. According to the cumulative contributions, essential reasons for the decline were increasing capital intensity and decreasing import exposure. However, the two variables alone markedly overstate the contraction, leaving a positive aggregate factor, captured by time fixed effects, unidentified.

Labour share's low levels in the first half of the 20th century are best explained with a low level to start with: the constant in my baseline specification predicts an average labour share of 51.8% in 1907. Staying low, on the other hand, was mainly due to increasing capital intensity, illustrated by a massive -15.6 p.p. contribution in Figure 11. At the time, the substitutability between labour and capital was good: motive power in many occasions was muscle,²²¹ which could be replaced by simple machinery once finance became available.²²²²²³ Another noteworthy factor was decreasing import exposure, a result of protectionist trade policy. Doubling of ad valorem tariffs and approving attitude towards cartels²²⁴ combined with the snowball effect of protectionism elsewhere²²⁵ squeezed import exposure by almost 70%. Protectionism restricted competition and consequently inflated profits, leading to a diminishing labour share.

Sudden noise in labour share fell down to acceleration of TFP in around 1920 and turmoil in labour market relations. The former owed much to the rapid electrification of production and improvements in factory design.²²⁶ The overall contribution of

²²¹This was the case especially in wood industry. See Ahvenainen, Pihkala, and Rasila 1982, pp. 230–241.

²²²In the 19th century U.S., capital paired with unskilled labour successfully substituted industrial handicraft, as production moved from artisanal shops to factories. Since the great majority of plants employed less than five employees in Finland as late as 1950 (*ibid.*, p. 411), the shift to factories was clearly ongoing in 1907–1943. See Lawrence F Katz and Margo 2013, pp. 1–9, and Goldin and Lawrence F. Katz 1998, pp. 694–698.

²²³The financial situation improved at least in two aspects from lenders' perspective in 1900–1950, as a number of new banks started operating, and inflation kept cutting the real value of debts. See Riitta Hjerpe, Peltonen, and Pihkala 1984, p. 47.

²²⁴Since several factory owners fought as officers for the victorious Whites in the Civil War, their benefit was of primary interest in the following decade. See Ojala and Karonen 2006, p. 107.

²²⁵Eichengreen 1995.

²²⁶According to Jalava, electricity's share of total motive power in manufacturing grew from 7% to almost 90% in 1900–1939. Jalava estimates, that electrification contributed approximately 33%

TFP remained modest, however, since the deterioration of technology due to WWI and the Civil War in particular took years to recover from. The latter refers to the aftermath of the Civil War and could be connected to distributional conflict in the rest of Europe.²²⁷ During the 1920s, the unions were in an upswing compared to the following decade, which shows in the labour share, as well. The Great Depression provided fuel for right-wing extremism, which at its starkest lead to the temporary shut down of the employees' central organisation, SAK.²²⁸

During the post-WWII decades until the 1990s crisis, labour share saw a spectacular increase, from 41.7% in 1943 to record-high 69.9% in 1991. Speaking in changes, this corresponds a 28.2 percentage point jump. Around a third of the increase is predicted by union density, while the bulk of it can be attributed to an aggregate trend.

After WWII, labour share was affected by conflicting pressures. Aggressive capital fundamentalism, accelerating convergence process and a shift towards mass production materialized in a sizable downward pressure from technology variables, $\frac{K}{L}$ ratio and TFP.²²⁹ However, the cut was more than compensated for by unknown aggregate level factors, captured by time fixed effects. Meanwhile, union density was growing fast: while circa 15% of industry employees belonged to an union in 1943, the proportion more than quadrupled by 1991. Majority of the increase took place in 1943–1945, due to the new political mandate of SAK established over the war, and again around the early 1970s, when the central organisation was unified after in-house disagreements of the preceeding decade.²³⁰ In consequence, union density had a non-trivial impact on labour share, corresponding to around 35% of the overall increase (10.0/28.2).²³¹ Import exposure's influence remained modest, because imports grew sluggishly pre-1990s.

Following the economic crisis of the 1990s, the labour share in Finnish industry

of TFP growth in Finland from 1920 to 1938. Jalava 2007, pp. 116–126.

²²⁷Eichengreen 1995, pp. 390–400.

²²⁸Jussila, Hentilä, and Nevakivi 2009, pp. 152–160.

²²⁹Kokkinen et al. 2007, pp. 164–168; Ahvenainen, Pihkala, and Rasila 1982, p. 410.

²³⁰See section 7.1.

²³¹In an analogous setting, Farber et al. find that an increase in union density can explain around 9% to 17% of the observed decline in Gini coefficient in the U.S. during 1940–1960. See Farber et al. 2018, p. 52.

experienced a historically drastic downturn. From top to bottom, the labour share sunk from record-high 69.9% to 46.2% in 1991–2007. Overall, the drop was 23.7 percentage points. This time around the key component was the rapid growth of TFP, which predicted approximately 60% of the total decrease ($-14.3/-23.7$).

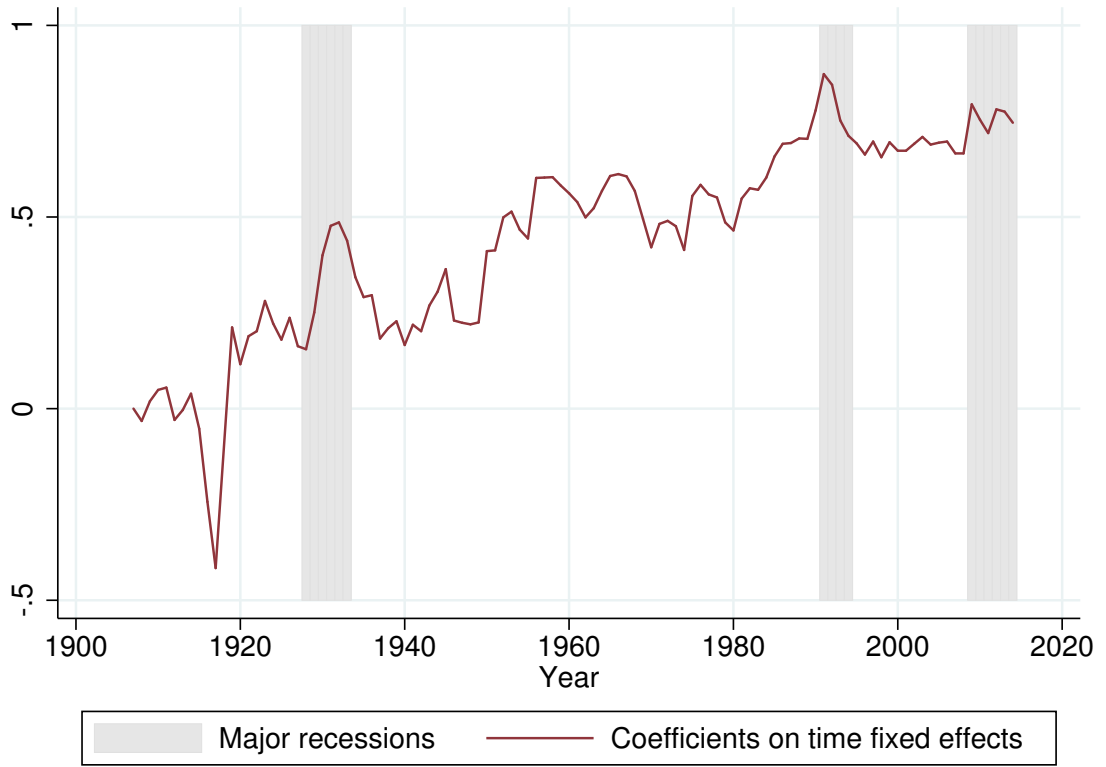
Roaming TFP growth rates corresponded to the booming ICT-industry and efficiency-improving downsizing across industrial branches.²³² Especially fast growers in addition to metal industry, which included ICT, were paper, food etc. and wood industries, all experiencing a TFP growth rate over 4%. Another reason for the declining labour share was the steady increase in capital intensity. The contribution of $\frac{K}{L}$ ratio was overshadowed by previous periods, since Finnish industry caught up with the technological frontier over the 1990s, which slowed down the growth rate of capital stock remarkably. Even so, note that capital intensity's contribution was downward biased due to growing monopoly rents. Import exposure experienced a considerable increase, matching with a noteworthy positive push on labour share as Finland entered the age of hyperglobalisation.²³³ Union density's modest contribution reflects the fact that the fraction of union members of total employees was stagnating.

Comparing the determinants of labour share against each other, especially notable is the significance of aggregate level variables, referring to time fixed effects. Although it is impossible to know what the time fixed effects are precisely capturing, I believe that the most plausible candidate is labour demand. My evaluation is in line with the profile of time fixed effects, presented in Figure 12. There, it is clear that some aggregate level variable lifted the bottom of labour share at least since WWII while keeping the explanatory variables in equation (18) constant. An important point to stress is that the variation of time fixed effects is most likely *not* related to technological change within industry, since the marginal effect of TFP and capital-labour ratio are negative in both time series analysis and in panel regressions. Labour demand, however, fits the overall pattern quite well: following the

²³²While Pohjola estimates, that ICT contributed nearly 40% ($\frac{(0.7+0.3)}{2.7} \approx 0.37$) of the aggregate TFP growth rate in Finland between 1996–2005, Maliranta argues, that business restructuring typically accounts for 20–50% of TFP growth within industries. See Pohjola 2017, p. 477 and Mika Maliranta 2005, p. 27.

²³³Haaparanta et al. 2017, p. 23.

Figure 12: Coefficients on time fixed effects from baseline specification (18)



Notes: The red line represents coefficients on time fixed effects from specification (18), which is the baseline model. The shaded areas represent major recessions, which are the Great Depression 1928–1933, the 1990s crisis 1991–1994 and the Great Recession 2009–2015.

unstable decades of the early 20th century including the Civil War, roaming inflation and the Great Depression, time fixed effects experience a steady increase, which is slightly disrupted by the stagflation years of the 1970s but ultimately cut by the 1990s crisis.²³⁴ Corresponding to booming labour demand, time fixed effects also modulate during the Golden Age of 1950–1970 and the manic 1980s. Over the three major recessions in 1928–1933, 1991–1994 and 2009–2015, the coefficients appear to peak, coinciding well with behaviour of the economic cycle.

To summarize, I have proposed that the key factors determining the changes in functional income distribution are technological advancement and shifts in bargaining

²³⁴The pattern of time fixed effects fits the business cycle description in Heikkinen 2017.

power. Due to the low starting point and high substitutability between labour and capital, labour share maintained a low level before WWII. During the four decades post-WWII, it grew almost 30 percentage points, of which roughly a third corresponds to an improvement in the bargaining position of employees. Following the 1990s recession, labour share declined continuously until 2007, before settling upon the levels of the 1940s in 2015. The primary reason behind the turnaround in the 1990s was a rapid growth of total factor productivity, predicting over a half of the decrease.

Furthermore, I would like to stress two points considering the recent decline in labour share. First, a significant difference in comparison to previous periods is the changing direction of common shocks. In 1991–2007, time fixed effects predicted a considerable reduction in labour share, in contrast to the past. I argue, that the gulf with the past could be due to a simultaneous transition from extensive to intensive growth. As Finnish industry caught up with the technological frontier over the 1990s, growth could no longer rely on technological borrowing and accruing of factor inputs. Consequently, labour demand moderated. Second, the downward bias in capital intensity's contribution is a pivotal detail. Without market imperfections the connection between capital accumulation and labour share should be positive rather than negative, neutralizing some or all of TFP's negative influence. Thus, increased monopoly rents have prevented the built-in balancing mechanism of neoclassical economy.

According to my analysis, technology emerges as the most important determinant of labour share in the long-term. The significance of technology complements previous research, which has found it to be essential in the recent and rather universal decline of labour share, beginning in around the 1970s.²³⁵ Earlier, and before WWII in particular, technology worked as a substitute for labour, which was only natural since machines were a lot faster in routine-intensive tasks than artisans. After mid-century, technology began to increasingly complement and add the efficiency of the workforce. In the ICT-era, technology is obviously still efficiency-improving, but this time it also works potentially through rising concentration. As internet has multiplied the scope of global markets, the market players have had to match the

²³⁵Section 3.2.

expansion. The emergence of bigger players, which Autor et al. title adequately as the superstar firms,²³⁶ suits with the economic history of Finnish industry, which experienced such restructuring around the 1990s crisis over an unforeseen wave of downsizings, mergers and bankruptcies.²³⁷

Secondary to technology, the changes in labour share are also driven by changes in bargaining power. Following Autor et al., I propose that the other end of bargaining power, namely market power, may have been squeezing labour share in recent decades, as ICT in tandem with globalisation has enabled industrial branches to concentrate. Working to the opposite direction, union power appears to have boosted labour share from 1943 to 1991, when majority of employees became organized. A noteworthy point is, that this was possibly a one-time event, since in 2015 union density is rather close to its theoretical maximum.

²³⁶See D. Autor, Dorn, F. Katz, et al. 2017. For related research, see Barkai 2016.

²³⁷Kyyrä and Mika Maliranta 2006.

9 Conclusions

This thesis was motivated with the following question: "What factors have determined the changes in labour share in Finnish industry over the 20th century?" In short, I conclude that the changes could be plausibly explained by advancements in production technology, along with shifts in the distribution of rents. Growing union density and import exposure predicted an increase in labour share, while greater TFP growth and capital accumulation appeared to increase capital share. My interpretation is that union density worked through improving the bargaining position of labour. Addedly, import exposure deteriorated the market power of capitalists by enhancing the competitive pressure on product markets. Capital accumulation reduced labour's proportion of total income by substituting routine-based work with machinery especially pre-WWII, but after that it captured mainly the effect of increasing monopoly rents. Finally, I propose that TFP growth increased the profitability of businesses, marking a genuine negative impact of labour saving technology on labour share. Statistically or economically significant relation with financialisation, public expenditure, devaluations or export exposure and the labour share could not be robustly identified.

On top of the selected explanatory variables, large part of the variation in labour share was left unexplained. This reflects the impact of time fixed effects, working like a tide lifting (or lowering) all boats. In chapter 8 I speculated that the time fixed effects could capture the influence of overall labour demand, or alternatively policy actions like taxation or collective wage agreements. Ultimately, however, their driver is left unknown. The relative importance of time fixed effects demonstrates the difficulty of identification in macroeconomic settings.²³⁸

Despite the limited explanatory power, I believe my analysis can extend our understanding of the key mechanisms determining factor shares. Especially the long-term drivers of labour share have thus far gone largely untested. Indeed, the most valuable insight of this thesis is the robust observation that technology was a big deal even before the ICT-revolution. Moreover, the historical meltdown of labour share since the beginning of the ICT-revolution was due to technology as well as the contraction

²³⁸For a splendid overview, see Nakamura and Steinsson 2017.

of compensating forces, referring to bargaining power of employees. Nonetheless, technology arises as the single most important force determining whether labour is gaining or losing, according to my analysis.

The universal decline of labour share is often viewed as a harmful trend. This is understandable, since lower labour shares typically imply higher income inequality, which may cause feelings of unfairness, social problems and social unrest. Another worry states that contracting labour share could remark the extinction of numerous jobs which could lead to similar troubles as rising inequality. Thus, reversing the decline might be of social planner's interest. Based on the results above, a somewhat comforting point is the observation that the decline of labour share is not purely driven by market forces. Since bargaining power counts, the position of labour can be improved by policy intervention. Taking account my analysis, one way to achieve this could be revising the antitrust laws: in theory, assuming no market imperfections, the impact of capital accumulation on labour share would be positive. Moreover, if capital accumulation grew at same rate as TFP, the two variables would equal each other out exactly, leaving labour share constant.²³⁹ If, however, making markets more competitive would prove out to be unfeasible for one reason or the other, another mean to even the odds would be strengthening the bargaining position of employees.

²³⁹Acemoglu 2003, pp. 1–3.

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Appendix A The model

In contrast to chapter 4, in this Appendix I present the extended neoclassical model applied in detail, including the necessary manipulations carried out when deriving the critical equations. Obviously, my starting point is the Constant Elasticity of Substitution (CES) production function:

$$Q = \left[\alpha(AL)^{-\rho} + (1 - \alpha)(BK)^{-\rho} \right]^{-\frac{1}{\rho}} \quad (25)$$

where α is a distribution parameter, ρ is a substitution parameter, and A and B represent the respective productive efficiencies. I.e. as A increases, the use of labour becomes more efficient, or alternatively, labour is saved. In addition, ρ and α satisfy the conditions $-1 < \rho < \infty$ and $0 < \alpha < 1$. Next, to ease interpretation later on, I derive an expression for the elasticity of substitution. By definition, elasticity of substitution is formulated as:

$$\sigma = \frac{\frac{d(K/L)}{K/L}}{\frac{d(MPL/MPK)}{MPL/MPK}} = \frac{d \ln \left(\frac{K}{L} \right)}{d \ln \left(\frac{MPL}{MPK} \right)} \quad (26)$$

where $MPL = \frac{\partial Q}{\partial L}$ is the marginal productivity of labour, and $MPK = \frac{\partial Q}{\partial K}$ is the marginal productivity of capital. To tackle the quest at hand, I compute the first-order conditions for equation (25):

$$\frac{\partial Q}{\partial L} = -\frac{1}{\rho} X^{-\frac{1}{\rho}-1} (-\rho \alpha A^{-\rho} L^{-\rho-1}),$$

where X is the term in square brackets. Simplifying:

$$\begin{aligned} &= X^{-\left(\frac{1}{\rho}+1\right)} \alpha A^{-\rho} L^{-(1+\rho)} \\ &= X^{-\left(\frac{1+\rho}{\rho}\right)} \alpha A^{-\rho} L^{-(1+\rho)} \\ &= X^{-\left(\frac{1}{\rho}\right)} X^{-\left(\frac{\rho}{\rho}\right)} \alpha A^{-\rho} L^{-(1+\rho)} \end{aligned}$$

Note that $X^{-\frac{1}{\rho}} = Q$, so $X^{-\left(\frac{\rho}{\rho}\right)} = Q^\rho$. Hence, we get:

$$\begin{aligned}
&= Q Q^\rho \alpha A^{-\rho} L^{-(1+\rho)} \\
&= \alpha A^{-\rho} L^{-(1+\rho)} Q^{1+\rho} \\
&= \alpha A^{-\rho} \left(\frac{Q}{L}\right)^{1+\rho}
\end{aligned} \tag{27}$$

Proceeding similarly, $\frac{\partial Q}{\partial K}$ is:

$$\frac{\partial Q}{\partial K} = (1 - \alpha) B^{-\rho} \left(\frac{Q}{K}\right)^{1+\rho} \tag{28}$$

Dividing (27) by (28) gives the *marginal rate of technical substitution*, $MRTS = \frac{MPL}{MPK}$, which is solved for $\frac{K}{L}$:

$$\begin{aligned}
\frac{\frac{\partial Q}{\partial L}}{\frac{\partial Q}{\partial K}} &= \frac{\alpha A^{-\rho} \left(\frac{Q}{L}\right)^{1+\rho}}{(1 - \alpha) B^{-\rho} \left(\frac{Q}{K}\right)^{1+\rho}} = \frac{\alpha}{1 - \alpha} \left(\frac{A}{B}\right)^{-\rho} \left(\frac{K}{L}\right)^{1+\rho} = \frac{MPL}{MPK} \\
\left(\frac{K}{L}\right)^{1+\rho} &= \frac{MPL}{MPK} \frac{(1 - \alpha)}{\alpha} \left(\frac{A}{B}\right)^\rho \\
\frac{K}{L} &= \left(\frac{MPL}{MPK}\right)^{\frac{1}{1+\rho}} \left(\frac{1 - \alpha}{\alpha}\right)^{\frac{1}{1+\rho}} \left(\frac{A}{B}\right)^{\frac{\rho}{1+\rho}}
\end{aligned}$$

Taking logarithms, and then a partial derivative with respect to $\ln\left(\frac{MPL}{MPK}\right)$ yields the elasticity:

$$\begin{aligned}
\ln \frac{K}{L} &= \frac{1}{1 + \rho} \ln\left(\frac{MPL}{MPK}\right) + \frac{1}{1 + \rho} \ln\left(\frac{1 - \alpha}{\alpha}\right) + \frac{\rho}{1 + \rho} \ln\left(\frac{A}{B}\right) \\
&\Rightarrow \frac{\partial \ln\left(\frac{K}{L}\right)}{\partial \ln\left(\frac{MPL}{MPK}\right)} = \frac{1}{1 + \rho} = \sigma
\end{aligned} \tag{29}$$

This implies equivalently, that $\rho = \frac{1 - \sigma}{\sigma}$.

Given the expression for ρ , I can start to derive more informative formulations for

both factor shares. Assuming that firms maximize profits, it is known that:

$$\begin{aligned}\frac{\partial Q}{\partial L} &= MPL = \frac{W}{P} \\ \frac{\partial Q}{\partial K} &= MPK = \frac{R}{P}\end{aligned}\tag{30}$$

where $\frac{W}{P}$, $\frac{R}{P}$ represent the real prices of both inputs.

Now, using (27), (28), (29) and (30), labour and capital share can be expressed as:

$$\begin{aligned}LS &= \frac{W}{P} \frac{L}{Q} = \frac{\partial Q}{\partial L} \frac{L}{Q} = \alpha A^{-\rho} \left(\frac{Q}{L}\right)^{1+\rho} \left(\frac{L}{Q}\right) = \alpha A^{-\rho} \left(\frac{Q}{L}\right)^{\rho} = \alpha \left(\frac{Q}{AL}\right)^{\frac{1-\sigma}{\sigma}} \\ CS &= (1 - \alpha) \left(\frac{Q}{BK}\right)^{\frac{1-\sigma}{\sigma}}\end{aligned}\tag{31}$$

According to equation (31), the relation between labour productivity, labour saving technology and labour share depends on the elasticity of substitution. Analogically, the relation between capital productivity, capital saving technology and capital share is determined by the elasticity.

Now, rewriting labour share in terms of $\frac{K}{L}$ allows us to examine how capital accumulation affects the labour share. Using (31) and (25):

$$\begin{aligned}LS &= \alpha \left(\frac{Q}{AL}\right)^{\rho} = \alpha \left(\frac{[\alpha(AL)^{-\rho} + (1 - \alpha)(BK)^{-\rho}]^{-\frac{1}{\rho}}}{AL}\right)^{\rho} \\ &= \alpha \left(\frac{[\alpha(AL)^{-\rho} + (1 - \alpha)(BK)^{-\rho}]^{-1}}{AL^{\rho}}\right) \\ &= \alpha([\alpha(AL)^{-\rho}(AL)^{\rho} + (1 - \alpha)(BK)^{-\rho}AL^{\rho}]^{-1}) \\ &= \alpha \left([\alpha + (1 - \alpha) \left(\frac{BK}{AL}\right)^{-\rho}]^{-1}\right) \\ &= \frac{\alpha}{\alpha + (1 - \alpha) \left(\frac{BK}{AL}\right)^{-\rho}} \\ \Rightarrow \frac{\partial LS}{\partial \left(\frac{K}{L}\right)} &= \frac{\alpha \rho (1 - \alpha) \left(\frac{B}{A}\right)^{-\rho} \left(\frac{K}{L}\right)^{-\rho-1}}{\left(\alpha + (1 - \alpha) \left(\frac{BK}{AL}\right)^{-\rho}\right)^2}\end{aligned}$$

Observe, that $\frac{1}{\alpha+(1-\alpha)\left(\frac{BK}{AL}\right)^{-\rho}} = \left(\frac{Q}{AL}\right)^\rho$. So the above can be simplified:

$$\begin{aligned}
&= \alpha\rho(1-\alpha) \left(\frac{B}{A}\right)^{-\rho} \left(\frac{K}{L}\right)^{-\rho-1} \left(\frac{Q}{AL}\right)^{2\rho} \\
&= \frac{1-\sigma}{\sigma} \alpha(1-\alpha) \left(\frac{Q}{AL}\right)^{2\left(\frac{1-\sigma}{\sigma}\right)} \left(\frac{BK}{AL}\right)^{-\left(\frac{1-\sigma}{\sigma}\right)} \left(\frac{K}{L}\right)^{-1} \\
&\Rightarrow \begin{cases} \frac{\partial LS}{\partial\left(\frac{K}{L}\right)} < 0, & \text{when } \sigma > 1 \\ \frac{\partial LS}{\partial\left(\frac{K}{L}\right)} > 0, & \text{when } \sigma < 1 \end{cases} \quad (32)
\end{aligned}$$

Where the implication in the end follows from the fact that all the other terms are necessarily positive except for $\frac{1-\sigma}{\sigma}$. The conclusion from equation (32) is, that an increase in capital accumulation, $\frac{K}{L}$, decreases labour share, when the elasticity of substitution is above unity. It has the opposite effect, when the elasticity is below unity.

Similarly, I can examine the effect of labour saving technology on labour share:

$$\begin{aligned}
\frac{\partial LS}{\partial A} &= -\frac{\alpha(-\rho)(1-\alpha) \left(\frac{BK}{L}\right)^{-\rho} \left(\frac{1}{A}\right)^{-\rho-1} \left(-\frac{1}{A^2}\right)}{\left(\alpha+(1-\alpha) \left(\frac{BK}{AL}\right)^{-\rho}\right)^2} \\
&= \alpha\rho(1-\alpha) \left(\frac{BK}{AL}\right)^{-\rho} \left(\frac{1}{A}\right)^{-1} \left(-A^{-2}\right) \left(\frac{Q}{AL}\right)^{2\rho} \\
&= \left(\frac{1-\sigma}{\sigma}\right) \alpha(1-\alpha) \left(\frac{Q}{AL}\right)^{2\left(\frac{1-\sigma}{\sigma}\right)} \left(\frac{BK}{AL}\right)^{-\left(\frac{1-\sigma}{\sigma}\right)} A \left(-A^{-2}\right) \\
&= \left(\frac{\sigma-1}{\sigma}\right) \alpha(1-\alpha) \left(\frac{Q}{AL}\right)^{2\left(\frac{1-\sigma}{\sigma}\right)} \left(\frac{BK}{AL}\right)^{-\left(\frac{1-\sigma}{\sigma}\right)} A^{-1} \\
&\Rightarrow \begin{cases} \frac{\partial LS}{\partial A} > 0, & \text{if } \sigma > 1 \\ \frac{\partial LS}{\partial A} < 0, & \text{if } \sigma < 1 \end{cases} \quad (33)
\end{aligned}$$

The above implies, that an increase in labour saving technology increases labour share in case the elasticity of substitution is greater than one. The opposite happens, when the elasticity is below one.

Next, I introduce the more plausible scenario, which accounts for imperfect compe-

tition. Suppose that there exist mark-ups, π , in the product markets, such that

$$\begin{aligned}\frac{\partial Q}{\partial L} &= MPL = \pi \frac{W}{P} \\ \frac{\partial Q}{\partial K} &= MPK = \pi \frac{R}{P}\end{aligned}$$

where $\pi > 1$. Solving for P

$$\Rightarrow P = \pi \frac{W}{\left(\frac{\partial Q}{\partial L}\right)}, P = \pi \frac{R}{\left(\frac{\partial Q}{\partial K}\right)}$$

Now, factor shares can be rewritten as:

$$\begin{aligned}LS &= \frac{W}{P} \frac{L}{Q} = W \frac{\left(\frac{\partial Q}{\partial L}\right)}{\pi W} \frac{L}{Q} = \frac{1}{\pi} \left(\frac{\partial Q}{\partial L}\right) \frac{L}{Q} = \frac{1}{\pi} \alpha \left(\frac{Q}{AL}\right)^{\frac{1-\sigma}{\sigma}} \\ CS &= \frac{1}{\pi} (1 - \alpha) \left(\frac{Q}{BK}\right)^{\frac{1-\sigma}{\sigma}}\end{aligned}\tag{34}$$

Equation (34) suggests, that an increase in mark-up squeezes both labour and capital shares. For labour share, I derive also the partial derivative:

$$\begin{aligned}\frac{\partial LS}{\partial \pi} &= -\frac{\frac{\alpha}{\pi^2} \left(\alpha + (1 - \alpha) \left(\frac{BK}{AL}\right)^{-\rho}\right)^2}{\alpha + (1 - \alpha) \left(\frac{BK}{AL}\right)^{-\rho}} = -\frac{\alpha}{\pi^2} \left(\alpha + (1 - \alpha) \left(\frac{BK}{AL}\right)^{-\rho}\right) \left(\frac{Q}{AL}\right)^{2\rho} \\ &= -\frac{\alpha}{\pi^2} \left(\frac{Q}{AL}\right)^{-\rho} \left(\frac{Q}{AL}\right)^{2\rho} = -\frac{\alpha}{\pi^2} \left(\frac{Q}{AL}\right)^{\frac{1-\sigma}{\sigma}}\end{aligned}\tag{35}$$

Which asserts the negative correlation.

Finally, considering market imperfections in labour markets as well, I introduce the possibility of wage bargaining. Suppose real wage is determined as a weighted average:

$$\frac{W}{P} = \gamma \frac{Q}{L} + (1 - \gamma) W_r$$

where $0 \leq \gamma \leq 1$ is a measure of bargaining power of employees. When employers can single-handedly dictate labour market conditions, meaning $\gamma = 0$, the real wage

equals some reservation wage $\frac{W}{P} = W_r$. On the other hand, if unions dominate the negotiation process, implying $\gamma = 1$, all the gains from increases in labour productivity accrue to wages, equivalently $\frac{W}{P} = \frac{Q}{L}$.

Taking account wage bargaining, labour share takes the following form:

$$LS = \frac{W}{P} \frac{L}{Q} = \left(\gamma \frac{Q}{L} + (1 - \gamma) W_r \right) \frac{L}{Q} = \gamma + (1 - \gamma) W_r \frac{L}{Q}$$

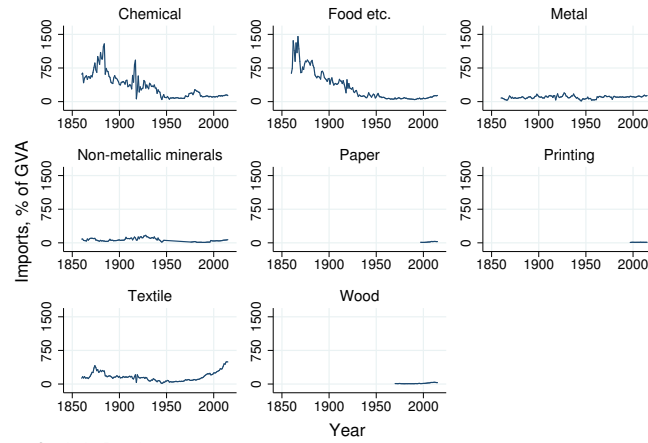
$$\Rightarrow \begin{cases} LS = 1, & \text{if } \gamma = 1 \\ LS = W_r \left(\frac{L}{Q} \right), & \text{if } \gamma = 0 \end{cases} \quad (36)$$

Translated to words, equation (36) implies that the greater the bargaining power of unions, the closer the labour share is to one (or 100%, when speaking in percentages).

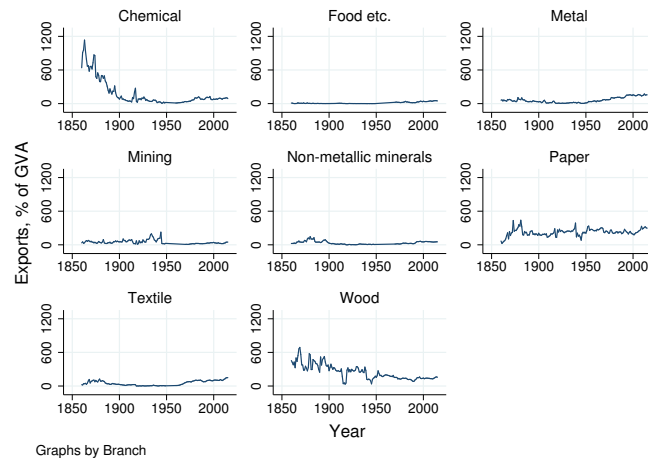
All in all, the selected model provides four important lessons for the mechanisms determining the labour share. These can be read from equations (32), (33), (35) and (36), and for convenience I offer a brief summary. The relation between capital-labour ratio, labour-saving technology and the labour share is tied to the elasticity of substitution. If the elasticity is below unity, an increase in the former has a positive effect on labour share, while the latter's impact is negative. In case the elasticity is above unity, the exact opposite applies. In comparison, accumulation of monopoly power always decreases labour share, while accumulation of bargaining power works the other way. In the empirical section, I show that the complete model can explain the patterns of Finnish labour share in industry during the last hundred years quite coherently.

Appendix B Figures and tables

Figure B1: Import and export exposure 1860–2015, by branch



(a)

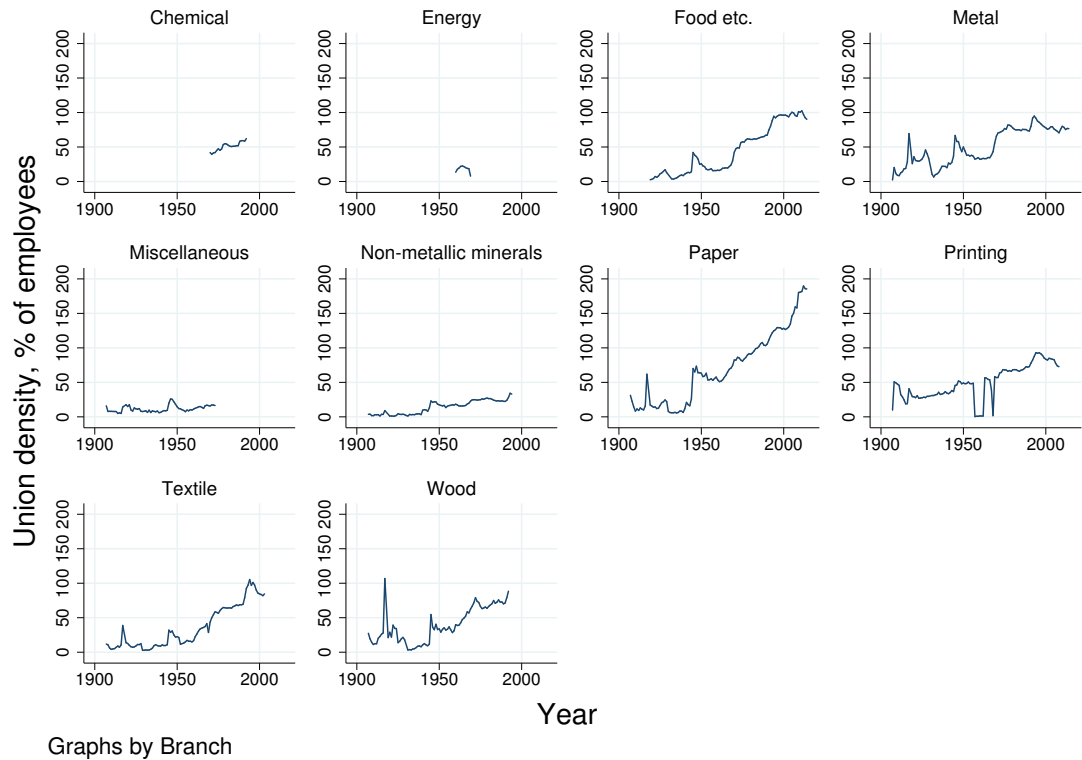


(b)

Notes: The branches with no observations have been omitted.

Sources: Exports and imports: Pihkala 1970; Oksanen & Pihkala 1975; Foreign trade statistics 1950–2001; Uljas database. GVA: Heikkinen & Hjerpe 1986; Hjerpe et al. 1976; NA 1960–1981; NA 1975–2015.

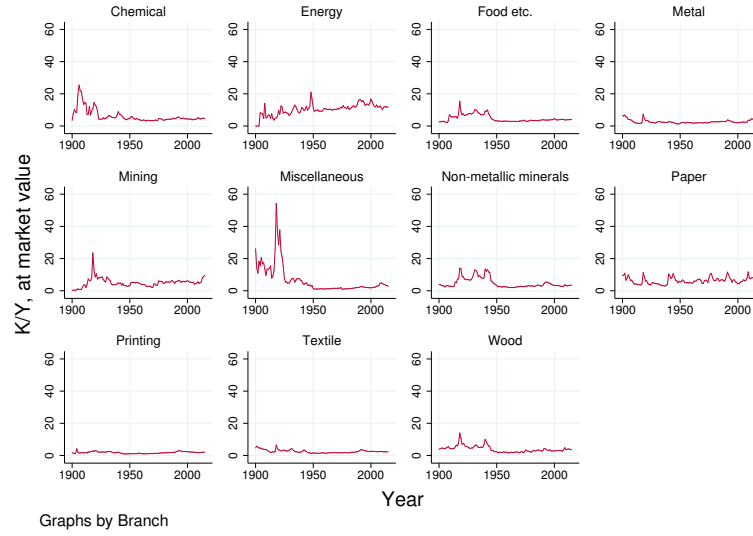
Figure B2: Union density 1907–2015, by branch



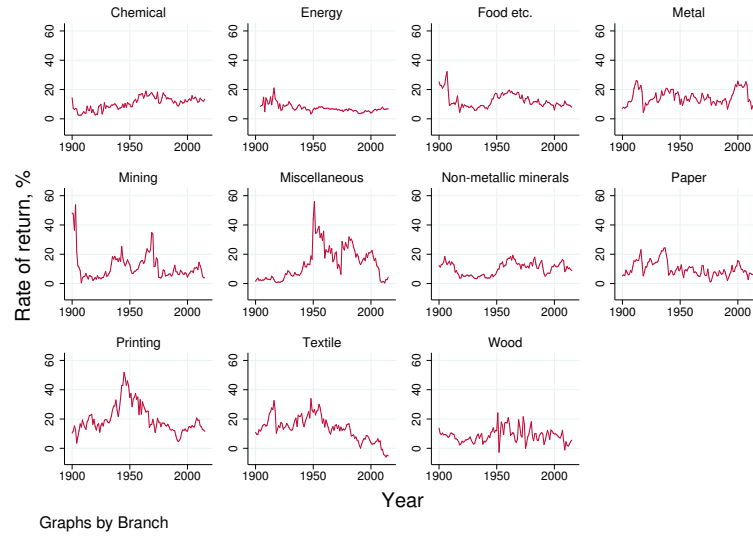
Notes: Paper industry's extraordinary high density is due to considerable amount of student and pensioner members. The gaps in printing industry's density correspond to the temporary shut down of the head union *Kirjatyöntekijäin liitto* in 1957 and again in 1968. Mining industry has been omitted due to only one observation.

Sources: Union members: Yli-Pietilä et al. 1990; *Statistical Yearbook of Finland* 1989–2015. Employees: Heikkinen & Hjerppe 1986; Hjerppe et al. 1976; NA 1960–1981; NA 1975–2015.

Figure B3: Capital-output ratio and rate of return on capital 1900–2015, by branch



(a)

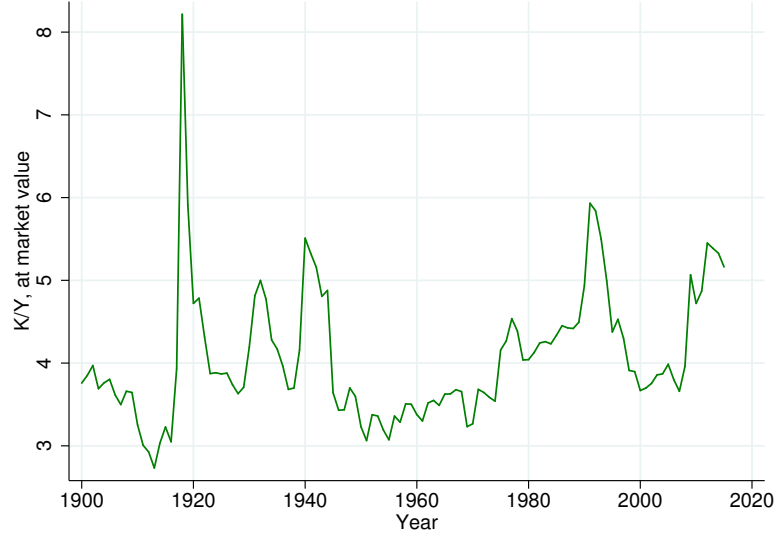


(b)

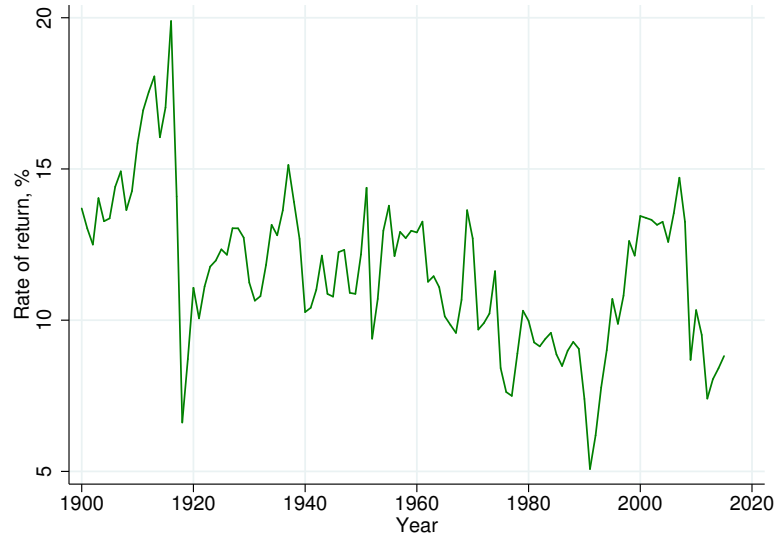
Notes: Rate of return on capital is defined as $r_{it} = CS_{it} / (\frac{K}{Y})_{it}$, where $CS = 100 - ALS$ is capital share, and $\frac{K}{Y}$ is capital-output ratio at market value.

Sources: Author's own calculation: see section 6.2.

Figure B4: Capital-output ratio and rate of return on capital 1900–2015, whole industry



(a)

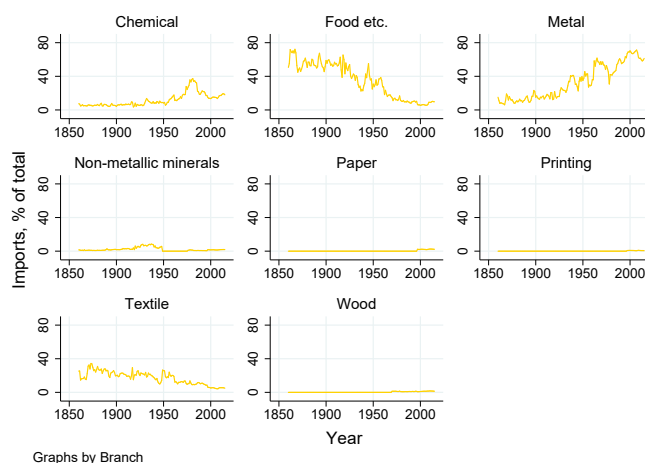


(b)

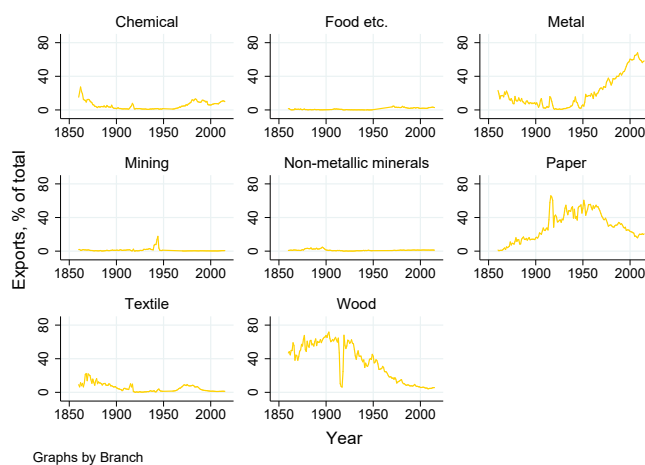
Notes: Rate of return on capital is defined as $r_{it} = CS_{it} / (\frac{K}{Y})_{it}$, where $CS = 100 - ALS$ is capital share, and $\frac{K}{Y}$ is capital-output ratio at market value.

Sources: Capital-output ratio for whole industry is calculated following the same steps as with the branch-level series. For details, see section 6.2.

Figure B5: Import and export shares 1860–2015, by branch



(a)

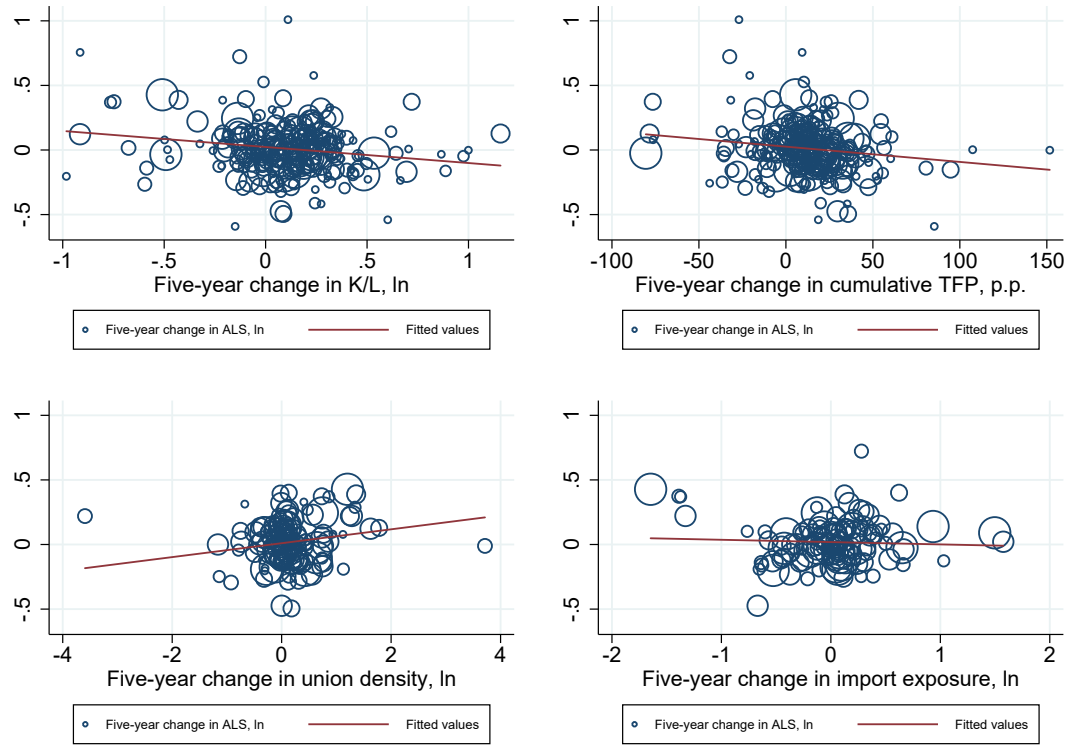


(b)

Notes: The branches with no observations have been omitted.

Sources: Pihkala 1970; Oksanen & Pihkala 1975; Foreign trade statistics 1950–2001; Uljas database. GVA: Heikkinen & Hjerpe 1986; Hjerpe et al. 1976; NA 1960–1981; NA 1975–2015.

Figure B6: Bivariate regressions between adjusted labour share and selected independent variables, using five-year differences



Notes: Each circle corresponds to one of the eleven branches in a bivariate regression of the form $\Delta \ln ALS_{it} = \beta_0 + \beta_1 X_{it} + \epsilon_{it}$, where X is one of the four explanatory variables. Each circle's size reflects each branch's average employment in 1907–2015. The sample period for the technology variables is 1900–2015, for union density 1907–2015, and for import exposure 1860–2015. The red lines represent the respective regression lines.

Table B1: Baseline models, with different definitions of labour share and lagged explanatory variables

	FE, OLS			
	(1) WS	(2) NALS	(3) ALS	(4) ALS
TFP	-0.23*** (0.04)	-0.37*** (0.06)	-0.12* (0.06)	-0.22** (0.06)
K/L	-0.36*** (0.09)	-0.38*** (0.11)		
Union density	0.12*** (0.04)	0.15*** (0.04)		
$\frac{M}{GVA}$	0.10*** (0.04)	0.15*** (0.05)	0.13*** (0.03)	0.13*** (0.03)
$\frac{X}{GVA}$	0.04* (0.02)	0.02 (0.03)	0.03 (0.02)	0.04 (0.03)
L3. K/L			-0.39*** (0.06)	
L5. K/L				-0.39*** (0.07)
L3. Union density			0.13*** (0.03)	
L5. Union density				0.13*** (0.03)
Constant	4.00*** (0.28)	3.96*** (0.16)	4.05*** (0.27)	4.02*** (0.27)
Branch fixed effects	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
Adj. R^2	0.61	0.72	0.72	0.71
N	388	367	388	386

Note: Dependent variable is the wage share in specification (1), net adjusted labour share in specification (2), and adjusted labour share in specifications (3) and (4). TFP is the growth rate of total factor productivity, $\frac{K}{L}$ is the real net capital stock per employee at 2010 constant prices, expressed at thousands of euros, density is the union density, $\frac{trade}{GVA}$ is the sum of $\frac{M}{GVA}$ and $\frac{X}{GVA}$, where the former is the value of imports as a share of GVA and the latter is the value of exports as a share of GVA. All variables are expressed as log levels, except for TFP, which is expressed as the annual growth rate in decimal form. Standard errors, which are block bootstrap in specifications (1) and (2) and clustered in models (3) and (4), in parentheses.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table B2: Baseline models, additional specifications

	FD, OLS		5-year FD, WLS	
	(1)	(2)	(3)	(4)
TFP	-0.43*** (0.09)	-0.46** (0.16)	-0.49** (0.15)	-0.50 (0.27)
K/L	-0.21** (0.08)	-0.23* (0.11)	-0.28* (0.12)	-0.54** (0.19)
Union density	0.04** (0.01)	0.04* (0.02)	0.12** (0.03)	0.15* (0.07)
$\frac{trade}{GVA}$	0.18** (0.07)		0.10** (0.03)	
$\frac{M}{GVA}$		0.16** (0.05)		0.18 (0.10)
$\frac{X}{GVA}$		0.04*** (0.01)		-0.05 (0.03)
Constant	0.07** (0.03)	0.06* (0.03)	0.07 (0.14)	0.08 (0.26)
Branch fixed effects	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
Branch-specific trends	No	No	Yes	Yes
Adj. R^2	0.33	0.41	0.37	0.43
N	571	372	102	63

Note: Dependent variable is the adjusted labour share. TFP is the growth rate of total factor productivity, $\frac{K}{L}$ is the real net capital stock per employee at 2010 constant prices, expressed at thousands of euros, density is the union density, $\frac{trade}{GVA}$ is the sum of $\frac{M}{GVA}$ and $\frac{X}{GVA}$, where the former is the value of imports as a share of GVA and the latter is the value of exports as a share of GVA. All variables in specifications (1) and (2) are expressed as log first differences, except for TFP, which is expressed as the annual growth rate in decimal form. In specifications (3) and (4), all variables are expressed as log first differences over five years, except for TFP, which is expressed as the cumulative growth over five years in decimal form. Specifications (3) and (4) have been weighted using each branch's average employment in 1907–2015. Clustered standard errors in parentheses.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table B3: Averages of selected variables, by branch

	ALS	TFP	$\frac{K}{L}$	$density$	$\frac{trade}{GVA}$	$\frac{M}{GVA}$	$\frac{X}{GVA}$	$strikes$	$\frac{K}{Y}$	r
Mining	65.8	3.3	101.5	30.5	50.2	.	50.2	637.3	5.0	11.4
Food etc.	48.0	1.1	62.7	45.6	334.6	323.6	12.8	476.1	4.7	12.4
Textile	62.9	2.3	17.7	35.7	212.3	162.4	53.3	396.7	2.5	13.7
Wood	66.3	2.2	37.2	39.6	250.4	16.0	245.6	589.0	4.0	8.7
Paper	44.7	3.4	193.7	70.3	227.8	20.3	225.3	801.1	6.3	10.0
Printing	71.3	1.4	27.1	50.0	12.2	12.2	.	903.3	1.8	19.9
Chemical	47.2	2.0	115.2	50.9	506.5	332.7	185.7	295.0	6.2	10.6
Non-metallic minerals	59.2	2.0	54.5	14.3	97.1	64.5	35.9	649.9	4.8	10.3
Metal	59.4	2.8	47.9	50.8	158.7	97.5	61.2	1533.4	2.7	14.7
Miscellaneous	64.0	2.1	43.0	11.7	.	.	.	240.5	6.5	14.0
Energy	27.4	1.5	566.1	18.2	.	.	.	195.6	10.3	7.4
Total	56.0	2.2	115.1	41.8	231.4	182.3	112.6	610.7	5.0	12.1

Note: The row *Total* refers to an arithmetic average of the eleven branches.

Source: See section 6.2.